MASS. TC80.2: D78/pt.1/v.2

UMASS/AMHERST
312066 0278 1290 2

FHWA-MA-EIS-82-02-DS2

CENTRAL ARTERY (I-93)/
THIRD HARBOR TUNNEL (I-90) PROJECT

GOVERNMENT DOCUMENTS
COLLECTION
NOV 2 1990
University of Massachusetts
Depository Copy

DRAFT
SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT/REPORT AND SUPPLEMENTAL FINAL SECTION 4(f) EVALUATION

Central Artery—Boston, Massachusetts

PART I – Vol. 2 of 2
- **Chapters 10–20**

Federal Highway Administration
Massachusetts Department of Public Works

Digitized by the Internet Archive
in 2015

https://archive.org/details/draftsupplementa12unit

FHWA-MA-EIS-82-02-DS2

CENTRAL ARTERY (I-93)/
THIRD HARBOR TUNNEL (I-90) PROJECT

DRAFT
SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT/REPORT AND SUPPLEMENTAL FINAL SECTION 4(f) EVALUATION

PART I – Vol. 2 of 2
• Chapters 10–20

Federal Highway Administration
Massachusetts Department of Public Works

Table of Contents

Table Of Contents

Page

PART I

1 SUMMARY 1

1 INTRODUCTION 1-1

1.1 PURPOSE OF SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/REPORT 1-1

1.2 PURPOSE AND NEED FOR ACTION 1-4

1.3 HISTORY OF PROJECT DEVELOPMENT 1-5

1.4 MAJOR POLICY ISSUES AFFECTING PROJECT DEVELOPMENT SINCE 1985 1-6

1.5 REGULATORY FRAMEWORK AND COMPLIANCE 1-10

1.6 ORGANIZATION OF THE SEIS/R 1-11

2 PROPOSED ACTION 2-1

2.1 OVERVIEW 2-1

2.2 PROJECT DESCRIPTION BY SUBAREA 2-2
2.2.1 Area North Of Causeway Street 2-3
2.2.2 Central Area 2-4
2.2.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area 2-5
2.2.4 South Boston/South Boston Bypass Road Area 2-7
2.2.5 Third Harbor Tunnel Area 2-8
2.2.6 East Boston/Logan Airport Area 2-9

2.3 COMPARISON OF THE PROPOSED ACTION TO THE FEIS/R PREFERRED ALTERNATIVE 2-10
2.3.1 Area North Of Causeway Street 2-10
2.3.2 Central Area 2-11
2.3.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area 2-11
2.3.4 South Boston/South Boston Bypass Road Area 2-12
2.3.5 Third Harbor Tunnel Area 2-12
2.3.6 East Boston/Logan Airport Area 2-12
2.3.7 High-Occupancy Vehicle (HOV) System 2-13
2.3.8 Tunnel Ventilation 2-15

Table Of Contents - Part I (Cont.)

Page

2.4 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 2-15

3 **TRANSPORTATION** 3-1

3.1 AFFECTED ENVIRONMENT 3-1
  3.1.1 Highway And Street Network 3-2
  3.1.2 Traffic Volumes 3-4
  3.1.3 Traffic Operations 3-4
  3.1.4 Truck Movements And Inflammable Cargo Routes 3-16
  3.1.5 Parking Facilities 3-19
  3.1.6 Safety 3-19
  3.1.7 Public Transit 3-20
  3.1.8 Air Transportation 3-21
  3.1.9 Pedestrian Circulation 3-21
  3.1.10 Bicycling 3-22

3.2 ENVIRONMENTAL CONSEQUENCES 3-23
  3.2.1 Summary Of Project Transportation Impacts 3-23
  3.2.2 Transportation Analysis Methodology 3-24
  3.2.3 Projected Traffic Volumes 3-27
  3.2.4 Projected Traffic Operations 3-52
  3.2.5 Other Projected Vehicular Traffic Characteristics 3-71
  3.2.6 Project Impacts On Other Transportation Facilities 3-90

3.3 MITIGATION MEASURES 3-98
  3.3.1 Traffic Surveillance And Control System (TSCS) 3-99
  3.3.2 Public Transportation 3-99
  3.3.3 Parking Supply Management 3-105
  3.3.4 Street Direction Changes 3-105

3.4 COMPARISON WITH FEIS/R 3-105

3.5 RESOLUTION OF ISSUES RAISED BY AGENCIES 3-107

4 **AIR QUALITY** 4-1

4.1 AIR POLLUTANTS 4-1

4.2 AIR QUALITY STANDARDS AND REGULATIONS 4-2
  4.2.1 National And State Ambient Air Quality Standards 4-2
  4.2.2 Massachusetts NO_2 Policy Level 4-2
  4.2.3 Toxic Pollutants In Vehicular Exhaust 4-4

4.3 POLLUTANTS FOR ANALYSIS 4-6

Table Of Contents - Part I (Cont.)

Page

4.4 AFFECTED ENVIRONMENT: EXISTING AIR QUALITY 4-7
  4.4.1 Monitored Levels 4-7
  4.4.2 Existing (1987) Carbon Monoxide Levels In The Project Area Estimated Based On Microscale Modeling 4-10
  4.4.3 Estimated Areawide Pollutant Emissions In 1987 (Mesoscale Analysis) 4-14

4.5 ENVIRONMENTAL CONSEQUENCES: CARBON MONOXIDE LEVELS IN 1998 WITH AND WITHOUT THE PROPOSED ACTION 4-23
  4.5.1 Estimated CO Levels In 1998 Based On Microscale Modeling 4-23
  4.5.2 Estimated Areawide Pollutant Emissions In 1998 With And Without The Proposed Action 4-28

4.6 ENVIRONMENTAL CONSEQUENCES: CARBON MONOXIDE LEVELS IN 2010 WITH AND WITHOUT THE PROPOSED ACTION 4-32
  4.6.1 Estimated CO Levels In 2010 Based On Microscale Modeling 4-32
  4.6.2 Estimated Areawide Pollutant Emissions In 2010 With And Without The Proposed Action 4-37

4.7 CARBON MONOXIDE LEVELS IN THE VICINITY OF TOLL PLAZAS 4-41

4.8 CARBON MONOXIDE CONCENTRATIONS IN PROPOSED TUNNELS 4-41
  4.8.1 Ventiliation Criteria 4-41
  4.8.2 Tunnel Design 4-42

4.9 TUNNEL VENTILATION SYSTEM 4-42
  4.9.1 Introduction 4-42
  4.9.2 Ventilation Requirements And Design Constraints 4-43
  4.9.3 Candidate Site Screening And Selection Process 4-44
  4.9.4 Comparative Evaluation Of Potential Ventilation Building Sites 4-45
  4.9.5 Ventilation System Design Concepts 4-46
  4.9.6 Proposed Ventilation System Design 4-46

4.10 AIR QUALITY IMPACTS OF VENTILATION BUILDINGS 4-46
  4.10.1 Emissions From Ventilation Buildings 4-48
  4.10.2 Air Quality Modeling Procedures 4-48
  4.10.3 Background Concentrations 4-56
  4.10.4 Results Of Analysis Of Automotive Exhaust Passing Through Ventilation Buildings 4-56
  4.10.5 Ventilation Building Design Considerations 4-59
  4.10.6 Combined Impacts From All Ventilation Buildings 4-59
  4.10.7 Combined Mobile Source And Ventilation Building Impacts 4-69

4.11 MITIGATION MEASURES 4-70

Table Of Contents - Part I (Cont.)

Page

4.12 COMPARISON WITH 1985 FEIS/R 4-70

4.13 CONFORMANCE WITH THE STATE IMPLEMENTATION PLAN 4-71

4.14 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 4-71

5 NOISE AND VIBRATION 5-1

5.1 AFFECTED ENVIRONMENT: NOISE 5-1
5.1.1 Ambient Noise Levels 5-1

5.2 ENVIRONMENTAL CONSEQUENCES: NOISE 5-2
5.2.1 Traffic Noise Impacts 5-2
5.2.2 Ventilation Noise Levels 5-23
5.2.3 Noise At Tunnel Portals 5-25

5.3 MITIGATION MEASURES: NOISE 5-25
5.3.1 Noise Barrier Analyses 5-26

5.4 COMPARISON WITH FEIS/R: NOISE 5-29

5.5 AFFECTED ENVIRONMENT: VIBRATION 5-30
5.5.1 Existing Vibration Levels 5-30

5.6 ENVIRONMENTAL CONSEQUENCES: VIBRATION 5-35
5.6.1 Vibration Impacts 5-35

5.7 MITIGATION MEASURES: VIBRATION 5-35

5.8 COMPARISON WITH FEIS/R: VIBRATION 5-36

5.9 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 5-36

6 ENERGY 6-1

6.1 AFFECTED ENVIRONMENT 6-1

6.2 ENVIRONMENTAL CONSEQUENCES 6-1
6.2.1 Direct Energy Analysis 6-1
6.2.2 Indirect Energy Analysis 6-3

6.3 MITIGATION MEASURES 6-3

6.4 COMPARISON WITH FEIS/R 6-3

6.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 6-5

Table Of Contents - Part I (Cont.)

Page

7 **ECONOMIC CHARACTERISTICS** 7-1

7.1 AFFECTED ENVIRONMENT 7-1
7.1.1 Changes In Regional Economy Since FEIS/R 7-1
7.1.2 Changes In Economic Activity Since FEIS/R By Subarea 7-20

7.2 ENVIRONMENTAL CONSEQUENCES 7-25
7.2.1 Metropolitan Economic Forecasts 7-26
7.2.2 Office Impacts 7-34
7.2.3 Retail Business Impacts 7-37
7.2.4 Industrial, Wholesale, And Maritime Business Impacts 7-40
7.2.5 Residential Impacts 7-43
7.2.6 Tourism Impacts 7-44
7.2.7 Impact On Institutions 7-50
7.2.8 Overall Impacts On The Economy 7-51
7.2.9 Transportation System Efficiency Benefits 7-51
7.2.10 Fiscal Impacts 7-54

7.3 MITIGATION MEASURES 7-56

7.4 COMPARISON WITH FEIS/R 7-57

7.5 RESOLUTION OF ISSUES RAISED BY AGENCIES 7-57

8 **LAND USE AND NEIGHBORHOOD CHARACTERISTICS** 8-1

8.1 AFFECTED ENVIRONMENT 8-1
8.1.1 Area North Of Causeway Street 8-2
8.1.2 Central Area 8-4
8.1.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area 8-8
8.1.4 South Boston And South Boston Bypass Road Area 8-10
8.1.5 East Boston/Logan Airport Area 8-12

8.2 ENVIRONMENTAL CONSEQUENCES/LAND USE IMPACTS 8-14
8.2.1 Land Use Impact Overvew 8-14
8.2.2 Neighborhood Impact Overview 8-15
8.2.3 Joint Development Overview 8-15
8.2.4 Relocation 8-15
8.2.5 Consistency Of Proposed Action With Local Plans 8-16
8.2.6 Regional Land Use Impacts 8-16
8.2.7 Specific Project-Related Land Use Changes 8-16
8.2.8 Land Use Impacts By Subarea 8-17

8.3 MITIGATION MEASURES 8-39

Table Of Contents - Part I (Cont.)

Page

8.4 COMPARISON WITH FEIS/R 8-40
  8.4.1 Area North Of Causeway Street 8-40
  8.4.2 Central Area 8-41
  8.4.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area 8-41
  8.4.4 South Boston And South Boston Bypass Road Area 8-42
  8.4.5 East Boston/Logan Airport Area 8-42

8.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 8-42

9 VISUAL CHARACTERISTICS 9-1

9.1 AFFECTED ENVIRONMENT 9-1
  9.1.1 Area North Of Causeway Street 9-1
  9.1.2 Central Area 9-2
  9.1.3 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area 9-4
  9.1.4 South Boston And South Boston Bypass Road Area 9-4
  9.1.5 East Boston/Logan Airport Area 9-5

9.2 ENVIRONMENTAL CONSEQUENCES 9-6
  9.2.1 The Charles River Bridges 9-7
  9.2.2 Gateways 9-8
  9.2.3 Tunnels 9-11
  9.2.4 Central Artery Corridor 9-12
  9.2.5 Ventilation Buildings 9-15

9.3 MITIGATION MEASURES 9-17
  9.3.1 Charles River Bridges 9-18
  9.3.2 Gateways 9-18
  9.3.3 Tunnels 9-19
  9.3.4 Central Artery Corridor 9-19
  9.3.5 Ventilation Buildings 9-19
  9.3.6 Projectwide 9-19

9.4 COMPARISON WITH FEIS/R 9-20
  9.4.1 Charles River Bridges 9-20
  9.4.2 Gateways 9-20
  9.4.3 Tunnels 9-20
  9.4.4 Central Artery Corridor 9-20
  9.4.5 Ventilation Buildings 9-21

9.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 9-21

Table Of Contents - Part I (Cont.)

Page

10 HISTORIC RESOURCES 10-1

10.1 AFFECTED ENVIRONMENT 10-1

10.2 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES 10-4

10.3 COMPARISON WITH FEIS/R 10-17

10.4 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 10-19

11 ARCHAEOLOGICAL RESOURCES 11-1

11.1 AFFECTED ENVIRONMENT 11-1

11.2 ENVIRONMENTAL CONSEQUENCES 11-4

11.3 MITIGATION MEASURES 11-4

11.4 COMPARISON WITH FEIS/R 11-5

11.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 11-5

12 UTILITIES 12-1

12.1 AFFECTED ENVIRONMENT 12-1

12.2 ENVIRONMENTAL CONSEQUENCES 12-1

12.3 MITIGATION MEASURES 12-4

12.4 COMPARISON WITH FEIS/R 12-4

12.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 12-5

13 WATER QUALITY 13-1

13.1 AFFECTED ENVIRONMENT 13-1
  13.1.1 Fort Point Channel 13-1
  13.1.2 Boston Inner Harbor 13-8
  13.1.3 Lower Charles River And Millers River 13-16
  13.1.4 Industrial Water Use 13-23
  13.1.5 Groundwater 13-23

13.2 ENVIRONMENTAL CONSEQUENCES 13-26
  13.2.1 Fort Point Channel 13-26
  13.2.2 Boston Inner Harbor 13-30

Table Of Contents - Part I (Cont.)

Page

13.2.3 Lower Charles River And Millers River 13-31
13.2.4 Projectwide Issues 13-33

13.3 MITIGATION MEASURES 13-39

13.4 COMPARISON WITH FEIS/R 13-40

13.5 SUMMARY OF MAJOR FINDINGS 13-41

13.6 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 13-42

14 WETLANDS AND WATERWAYS 14-1

14.1 AFFECTED ENVIRONMENT 14-3
14.1.1 Lower Charles River And Millers River 14-3
14.1.2 Fort Point Channel 14-12
14.1.3 Boston Inner Harbor 14-16

14.2 ENVIRONMENTAL CONSEQUENCES 14-29
14.2.1 Lower Charles River and Millers River 14-30
14.2.2 Fort Point Channel 14-39
14.2.3 Boston Inner Harbor 14-43

14.3 MITIGATION 14-49

14.4 COMPARISON WITH FEIS/R 14-51

14.5 RESOLUTION OF MAJOR ISSUES RAISED BY PUBLIC AGENCIES 14-52

15 FLOODPLAINS 15-1

15.1 AFFECTED ENVIRONMENT 15-1

15.2 ENVIRONMENTAL CONSEQUENCES 15-1

15.3 MITIGATION MEASURES 15-2

15.4 COMPARISON WITH FEIS/R 15-3

15.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 15-3

16 VEGETATION AND WILDLIFE 16-1

16.1 AFFECTED ENVIRONMENT 16-1

16.2 ENVIRONMENTAL CONSEQUENCES 16-1

Table Of Contents - Part I (Cont.)

Page

16.3 MITIGATION MEASURES 16-2

16.4 COMPARISON WITH FEIS/R 16-2

16.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 16-2

17 SOILS AND GEOLOGY 17-1

17.1 AFFECTED ENVIRONMENT 17-1

17.2 ENVIRONMENTAL CONSEQUENCES 17-2

17.3 MITIGATION MEASURES 17-2

17.4 COMPARISON WITH FEIS/R 17-2

17.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 17-2

18 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES 18-1

18.1 INTRODUCTION 18-1

18.2 COMMITMENT OF RESOURCES 18-1

18.3 RELATIONSHIP TO OTHER PROJECTS 18-2

18.4 RESOLUTION OF ISSUES RAISED BY AGENCIES 18-6

19 SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY 19-1

19.1 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY 19-1

19.2 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 19-3

20 SUMMARY OF CONSTRUCTION ACTIVITY 20-1

20.1 PROPOSED CONSTRUCTION PLAN 20-1
  20.1.1 Construction Activities 20-2
  20.1.2 Construction Schedule And Sequencing 20-10
  20.1.3 Construction Managment 20-13

20.2 IMPACTS DURING CONSTRUCTION 20-16
  20.2.1 Traffic And Transportation 20-16

Table Of Contents - Part I (Cont.)

Page

20.2.2 Economic Activity During Construction 20-36
20.2.3 Utilities 20-49
20.2.4 Air Quality 20-53
20.2.5 Noise And Vibration 20-59
20.2.6 Water Resources, Ecology And Wetlands 20-69
20.2.7 Aesthetic And Visual Considerations 20-83
20.2.8 Historic Resources And Archaeology 20-88
20.2.9 Nuisance Abatement 20-89

20.3 MITIGATION MEASURES 20-93
20.3.1 Mitigation Planning 20-94
20.3.2 Maintenance Of Traffic Plan 20-95
20.3.3 Mitigation Program Summary 20-96

20.4 COMPARISON WITH FEIS/R 20-99
20.4.1 Construction Methods 20-99
20.4.2 Traffic And Transportation 20-100
20.4.3 Economic Effects 20-100
20.4.4 Utilities 20-101
20.4.5 Air Quality 20-102
20.4.6 Noise And Vibration 20-102
20.4.7 Water Resources And Ecology 20-103
20.4.8 Aesthetic And Visual Impacts During Construction 20-104
20.4.9 Historic Resources And Archaeology 20-104
20.4.10 Nuisance Abatement 20-104

20.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES 20-104
20.5.1 Analysis Of Air Quality, Traffic, And Noise Impacts 20-104
20.5.2 Delayed Completion Of Seaport Access Road And Opening Of Third Harbor Tunnel 20-105
20.5.3 Maintenance Of Traffic 20-105
20.5.4 Conveyor System 20-105
20.5.5 Public Agency Participation 20-106

AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE SEIS/R WERE SENT

LIST OF PREPARERS

GLOSSARY

ABBREVIATIONS

INDEX

Table Of Contents - Part II

Page

PART II

A INTRODUCTION IIA-1

B ANALYSIS OF ALTERNATIVE DESIGN OPTIONS

1 AREA NORTH OF CAUSEWAY STREET IIB 1-1

1.1 INTRODUCTION IIB 1-1
1.1.1 Background IIB 1-1
1.1.2 Design Objectives IIB 1-3
1.1.3 Evolution Of Roadway Options IIB 1-7

1.2 DESCRIPTION OF OPTIONS IIB 1-8
1.2.1 Option 5A Modified IIB 1-8
1.2.2 Option S Modified IIB 1-10
1.2.3 Option T Modified IIB 1-12
1.2.4 Option Z Modified IIB 1-14

1.3 TRAFFIC OPERATIONS IIB 1-15
1.3.1 Method Of Analysis IIB 1-16
1.3.2 Option 5A Modified IIB 1-18
1.3.3 Option S Modified IIB 1-19
1.3.4 Option T Modified IIB 1-20
1.3.5 Z Modified IIB 1-21
1.3.6 Comparison Of Traffic Operations And Impacts IIB 1-23
1.3.7 Pedestrian/Bicycle Circulation IIB 1-24

1.4 LONG-TERM ENVIRONMENTAL IMPACTS IIB 1-37
1.4.1 Air Quality IIB 1-37
1.4.2 Noise IIB 1-41
1.4.3 Wetlands, Aquatic Ecology, And Water Quality IIB 1-44
1.4.4 Floodplains IIB 1-48
1.4.5 Waterways/Navigation IIB 1-48
1.4.6 Land Use Impacts IIB 1-50
1.4.7 Open Space And Parkland IIB 1-52
1.4.8 Visual Impacts IIB 1-57
1.4.9 Relocation Impacts IIB 1-63
1.4.10 Historic Resources IIB 1-65

1.5 CONSTRUCTION PERIOD IMPACTS IIB 1-67
1.5.1 Traffic Impacts IIB 1-67
1.5.2 Air Quality Impacts IIB 1-68
1.5.3 Noise And Vibration IIB 1-68
1.5.4 Wetlands, Aquatic Ecology, And Water Quality IIB 1-69

Table Of Contents - Part II (Cont.)

Page

1.5.5 Floodplains IIB 1-69
1.5.6 Waterways/Navigation IIB 1-70
1.5.7 Land Use IIB 1-71
1.5.8 Open Space And Parklands IIB 1-71
1.5.9 Visual Impacts IIB 1-72
1.5.10 Relocation IIB 1-72
1.5.11 Historic Resources IIB 1-72
1.5.12 Constructibility IIB 1-72
1.5.13 Construction Of Tunnels Under The Charles River IIB 1-75

1.6 RELATED DESIGN ISSUES IIB 1-79
1.6.1 Ventilation Building Locations IIB 1-79
1.6.2 Potential Bridge Design Modifications IIB 1-81

1.7 COMPARISON OF OPTIONS IIB 1-83
1.7.1 Summary Of Findings On Selected Key Issues IIB 1-95
1.7.2 Conclusion IIB 1-97

1.8 PROPOSED MITIGATION MEASURES IIB 1-97

2 SOUTH BOSTON BYPASS ROAD IIB 2-1

2.1 PURPOSE OF THE BYPASS ROAD IIB 2-1

2.2 BACKGROUND IIB 2-1
2.2.1 Haul Road IIB 2-2
2.2.2 Bypass Road Study Schemes IIB 2-2

2.3 ALTERNATIVES CONSIDERED IN THIS ANALYSIS IIB 2-3
2.3.1 Haul Road (The No-Action Alternative) IIB 2-3
2.3.2 Bypass Road (The Proposed Action) IIB 2-5

2.4 ASSESSMENT OF IMPACTS IIB 2-7
2.4.1 Traffic/Transportation IIB 2-7
2.4.2 Environmental Impacts IIB 2-12
2.4.3 Other Impacts IIB 2-20

2.5 SELECTION OF PROPOSED ACTION IIB 2-22
2.5.1 Summary Comparison Of Alternatives IIB 2-22
2.5.2 Selection Of Preferred Alternative IIB 2-23

3 TOLL PLAZA LOCATIONS IIB 3-1

3.1 DEVELOPMENT OF ALTERNATIVES IIB 3-1
3.1.1 Design Objectives IIB 3-1
3.1.2 Background IIB 3-2

Page

3.2 DESCRIPTION OF ALTERNATIVES IIB 3-3
3.2.1 Design Constraints IIB 3-3
3.2.2 South Boston Toll Plaza IIB 3-4
3.2.3 Logan Airport Toll Plazas IIB 3-5

3.3 ALTERNATIVES ANALYSIS IIB 3-5
3.3.1 Traffic And Transportation IIB 3-5
3.3.2 Environmental Issues IIB 3-9
3.3.3 Land Use And Community Facilities IIB 3-12

3.4 SELECTION OF PROPOSED ACTION IIB 3-14
3.4.1 Summary Comparison Of Toll Plaza Alternatives IIB 3-14
3.4.2 Selection Of Proposed Action IIB 3-15

4 MATERIALS DISPOSAL IIB 4-1

4.1 INTRODUCTION IIB 4-1
4.1.1 Purpose Of This Chapter IIB 4-1
4.1.2 Basis For Developing Disposal Options IIB 4-3
4.1.3 Organization Of This Chapter And Key Issues IIB 4-5

4.2 DISPOSAL METHODS, LOGISTICS, AND MATERIAL CHARACTERISTICS IIB 4-7
4.2.1 Artery/Tunnel Project Construction Areas IIB 4-7
4.2.2 Transportation Methods And Materials Movement Options IIB 4-8
4.2.3 Material Quantities IIB 4-15
4.2.4 Material Quality IIB 4-16

4.3 IDENTIFICATION OF POTENTIAL DISPOSAL SITES IIB 4-27
4.3.1 Artery/Tunnel Disposal Site Screening Report IIB 4-28
4.3.2 MWRA Residuals Management Facilities Plan IIB 4-28

4.3.3 Massachusetts DEP IIB 4-30
4.3.4 Additional Sites IIB 4-30
4.3.5 Summary Disposal Site Inventory IIB 4-31

4.4 SITE SCREENING PROCESS IIB 4-31
4.4.1 Site Requirements And Screening Criteria IIB 4-32
4.4.2 Disposal Program Planning Considerations IIB 4-36

4.5 BENEFICIAL USE OF NATIVE CLAY AND TILL IIB 4-36
4.5.1 Volume IIB 4-37
4.5.2 Transport Modes IIB 4-37
4.5.3 Disposal Sites IIB 4-38

Table Of Contents - Part II (Cont.)

Page

4.6 DISPOSAL OF ACCEPTABLE DREDGED MATERIAL IIB 4-40
  4.6.1 Volume IIB 4-40
  4.6.2 Transport Modes IIB 4-41
  4.6.3 Disposal Sites IIB 4-41

4.7 DISPOSAL OF UNACCEPTABLE DREDGED MATERIAL IIB 4-42
  4.7.1 Volume IIB 4-42
  4.7.2 Transport Modes IIB 4-42
  4.7.3 Disposal Sites IIB 4-42

4.8 DISPOSAL OF FILL AND UNSORTED CLAY AND TILL IIB 4-43
  4.8.1 Volume IIB 4-43
  4.8.2 Transport Modes IIB 4-43
  4.8.3 Disposal Sites IIB 4-44
  4.8.4 Description Of Existing Conditions At Potential Disposal Sites IIB 4-57
  4.8.5 Environmental Impacts Of Potential Disposal Sites IIB 4-91

4.9 COMPARISON OF ENVIRONMENTAL IMPACTS OF ALTERNATIVE DISPOSAL APPROACHES IIB 4-127
  4.9.1 Introduction IIB 4-127
  4.9.2 Comparison Of Marine Sites IIB 4-129
  4.9.3 Description Of Alternative Disposal Approaches IIB 4-130
  4.9.4 Key Impact Issues For Comparing Disposal Approaches IIB 4-135
  4.9.5 Environmental Impacts Of Alternative Disposal Approaches IIB 4-145
  4.9.6 Costs IIB 4-150
  4.9.7 Summary Of Comparison Of Alternative Disposal Approaches IIB 4-150

4.10 THE PROPOSED ACTION IIB 4-151

4.11 POTENTIAL SUPPLEMENTARY DISPOSAL UNDER INVESTIGATION AT LOGAN AIRPORT IIB 4-152

C OTHER DESIGN REFINEMENTS IIC-1

D FURTHER DESIGN MODIFICATIONS CURRENTLY UNDER CONSIDERATION IID-1

PART III

SECTION 4(f) EVALUATION

Page

1 INTRODUCTION III-1

2 PARKLANDS III-2

2.1 AREA NORTH OF CAUSEWAY STREET III-2
- 2.1.1 Proposed Action And Other Schemes Considered In The SEIS/R III-2
- 2.1.2 Leverett Circle/Storrow Drive (Charles River Esplanade) III-3
- 2.1.3 Designated MDC Nashua Street Parkland III-6
- 2.1.4 MDC Parkland At The Former GSA Site III-7
- 2.1.5 Paul Revere Landing Park III-7
- 2.1.6 Avoidance Alternatives III-11
- 2.1.7 Overall Comparison Of Impacts Of Area North Of Causeway Street Design Options On 4(f) Parkland III-11
- 2.1.8 Measures To Minimize Harm To 4(f) Parkland Resources In The Area North Of Causeway Street III-16

2.2 EAST BOSTON MEMORIAL STADIUM PARK III-21
- 2.2.1 Proposed Action III-21
- 2.2.2 Description Of The Section 4(f) Property III-22
- 2.2.3 Impacts On Section 4(f) Property III-23
- 2.2.4 Avoidance Alternatives III-25
- 2.2.5 Measures To Minimize Harm III-26

2.3 SPECTACLE ISLAND III-27
- 2.3.1 Proposed Action III-27
- 2.3.2 Description Of The Section 4(f) Property III-27
- 2.3.3 Impacts On The Section 4(f) Property III-29
- 2.3.4 Avoidance Alternatives III-29
- 2.3.5 Measures To Minimize Harm III-30

2.4 OTHER NEARBY PARKLANDS NOT USED OR AFFECTED III-30
- 2.4.1 Lester J. Rotch Playground, South End III-30
- 2.4.2 Pagoda Park, Chinatown/Leather District III-31
- 2.4.3 Gateway Park, Chinatown III-31
- 2.4.4 Christopher Columbus Park, Downtown Waterfront III-31
- 2.4.5 Union Park And Curley Memorial Park, Haymarket Area III-32
- 2.4.6 John S. Flaherty Park, South Boston III-32
- 2.4.7 Bird Island Flats Park, East Boston/Logan Airport III-33
- 2.4.8 Porzio Park, East Boston III-33
- 2.4.9 Battleship Park, South Boston III-33

Table Of Contents - Part III (Cont.)

Page

3 HISTORIC RESOURCES III-34

3.1 CHARLES RIVER BASIN HISTORIC DISTRICT III-35
- 3.1.1 Proposed Action III-35
- 3.1.2 Description Of The Section 4(f) Property III-35
- 3.1.3 Impacts On The Section 4(f) Property III-35
- 3.1.4 Avoidance Alternatives III-35
- 3.1.5 Measures To Minimize Harm III-36

3.2 CAUSEWAY/NORTH WASHINGTON STREETS HISTORIC DISTRICT III-36
- 3.2.1 Proposed Action III-36
- 3.2.2 Description Of The Section 4(f) Property III-36
- 3.2.3 Impacts On The Section 4(f) Property III-36
- 3.2.4 Avoidance Alternatives III-37
- 3.2.5 Measures To Minimize Harm III-37

3.3 FORT POINT CHANNEL HISTORIC DISTRICT III-37
- 3.3.1 Proposed Action III-37
- 3.3.2 Description Of The Section 4(f) Property III-38
- 3.3.3 Impacts On The Section 4(f) Property III-39
- 3.3.4 Avoidance Alternatives III-40
- 3.3.5 Measures To Minimize Harm III-41

4 ARCHAEOLOGICAL RESOURCES III-42

5 COORDINATION III-43

List Of Figures

Figure No.	Title	After Page

PART I

Figure No.	Title	After Page
1.1	Central Artery Congestion	1-4
1.2	Regional Highway System	1-6
1.3	Study Area	1-6
1.4	Proposed Action - Central Artery/Tunnel Project	1-6
1.5	Potential State And Federal Permits And Approvals	1-10
2.1	Proposed Action - Central Artery/Tunnel Project	2-2
2.2	Existing Facilities Diagram	2-2
2.3	Proposed Facilities Diagram	2-2
2.4	Project Subareas Key Plan	2-2
2.5	Area North Of Causeway Street Alignment	2-4
2.6	Area North Of Causeway Street Section	2-4
2.7	Area North Of Causeway Street Major Traffic Movements	2-4
2.8	Central Area Alignment	2-4
2.9	Central Area Surface Street Alignment	2-4
2.10	Central Area Sections	2-6
2.11	Central Area Major Traffic Movements	2-6
2.12	I-93/I-90 Interchange And Massachusetts Avenue Interchange Area Alignment	2-6
2.13	I-93/I-90 Interchange And Massachusetts Avenue Interchange Area Sections A-A And B-B	2-6
2.14	I-93/I-90 Interchange And Massachusetts Avenue Interchange Area Section C-C	2-6

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
2.15	I-93/I-90 Interchange And Massachusetts Avenue Interchange Area Major Traffic Movements	2-8
2.16	South Boston/South Boston Bypass Road Area Alignment (Northern Area)	2-8
2.17	South Boston/South Boston Bypass Road Area Sections A-A And B-B (Northern Area)	2-8
2.18	South Boston/South Boston Bypass Road Area Alignment (Southern Area)	2-8
2.19	South Boston/South Boston Bypass Road Area Sections C-C And D-D (Southern Area)	2-8
2.20	South Boston/South Boston Bypass Road Area Major Traffic Movements (Northern Area)	2-8
2.21	South Boston/South Boston Bypass Road Area Major Traffic Movements (Southern Area)	2-8
2.22	Third Harbor Tunnel Area Alignment	2-8
2.23	Third Harbor Tunnel Area Typical Section	2-10
2.24	Third Harbor Tunnel Area Major Traffic Movements	2-10
2.25	East Boston/Logan Airport Area Alignment	2-10
2.26	East Boston/Logan Airport Area Sections	2-10
2.27	East Boston/Logan Airport Area Major Traffic Movements	2-10
2.28	Major Design Revisions Since 1985 FEIS/R	2-10
3.1	Transportation Study Area	3-2
3.2	Regional Highway System	3-2
3.3	Mainline Highway Segments - Existing	3-6
3.4	Local Traffic Operations - Existing	3-10
3.5	Existing South Boston Truck Routes 1990	3-18

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
3.6	Inflammable Cargo Truck Routes	3-18
3.7	Structure Of The Forecasting Process	3-26
3.8	2010 Future Baseline Cordon Crossings: AM And PM Peak Hours; 24 Hours	3-36
3.9	2010 Proposed Action Cordon Crossings: AM And PM Peak Hours; 24 Hours	3-36
3.10	Proposed Action Highway Links, Ramps And HOV's - Area North Of Causeway Street	3-36
3.11	Proposed Action Highway Links, Ramps And HOV's - Central Area	3-36
3.12	Proposed Action Highway Links, Ramps And HOV's - I-93/I-90 Interchange And Mass. Ave. Interchange Area	3-36
3.13	Proposed Action Highway Links, Ramps And HOV's - So. Boston/So. Boston Bypass Road Area	3-36
3.14	Proposed Action Highway Links, Ramps And HOV's - So. Boston/So. Boston Bypass Road Area	3-36
3.15	Proposed Action Highway Links, Ramps And HOV's - East Boston/Logan Airport Area	3-36
3.16	Average Weekday Traffic Volumes On Major Highway Links	3-36
3.17	Screenline Crossings	3-40
3.18	Overview Of Traffic Operating Conditions: 2010 Baseline And Proposed Action	3-56
3.19	Intersection Analysis Sites	3-60
3.20	2010 Future Baseline - Surface Artery AWDT Volumes	3-68
3.21	2010 Proposed Action - Surface Roadway AWDT Volumes	3-68
3.22	Hours Of Congestion: 1987, 2010 Baseline And 2010 Proposed Action	3-72

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
3.23	Permanent Parking Impacts And Replacement Sites	3-90
3.24	New Pedestrian Connections	3-96
4.1	Location Of Mobile Source Air Quality Analysis Sites	4-12
4.2 (a) & (b)	Mobile Source Receptor Analysis Sites - East Boston Toll Plaza	4-12
4.3	Affected Zones For Meso Scale Air Quality Analysis	4-20
4.4	Ventilation Building Locations	4-48
4.5	Location Of Receptor Sites For Vent Bldg. No. 3 (Boston Edison) Wind Tunnel Study	4-56
4.6	Location Of Receptor Sites For Vent Bldg. No. 4 (Parcel 7) Wind Tunnel Study	4-56
5.1	Noise Receptor Locations In Project Subareas	5-4
5.2	Location Of Noise Barrier Analyses - Area North of Causeway Street	5-26
5.3	Location Of Noise Barrier Analyses - Central Area	5-28
5.4	Location Of Noise Barrier Analyses - I-93/I-90 Interchange And Massachusetts Avenue Interchange Area	5-28
5.5	Location Of Noise Barrier Analyses - South Boston And South Boston Bypass Road Area	5-28
5.6	Location Of Noise Barrier Analyses - East Boston/Logan Airport Area	5-30
5.7	Vibrations Measurement Locations	5-30
6.1	Total Energy Consumption By Vehicles	6-2
7.1	Boston Metropolitan Area	7-2
7.2	Population/Employment Trends In The Boston New England County Metropolitan Area	7-2
7.3	Employment In The Boston Metropolitan Area	7-2

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
7.4	Economic Analysis Subareas	7-2
7.5	Distribution Of Floor Space Use In Study Area, 1987	7-6
7.6	Distribution Of Boston Employment By Sector, 1980 And 1988	7-6
7.7	Mix Of Retail Sales	7-10
7.8	Mode Of Access To Shopping Districts	7-10
7.9	Distribution Of New Industrial Construction In Metropolitan Boston (NECMA) 1988	7-14
7.10	Central Area Building Area, 1987	7-24
7.11	Distribution Of Central Area Employment, 1987	7-24
7.12	Current Office Tenant Mix In Downtown Boston And Suburbs 1988	7-36
7.13	Projected Tourism Expenditures For Greater Boston Area	7-50
8.1	Major Land Use Changes Since 1983 - Project Area	8-4
8.2	Major Land Use Changes Since 1983 - Downtown	8-4
8.3	Area North Of Causeway Street	8-4
8.4	Central Area	8-4
8.5	Central Area	8-8
8.6	Chinatown/South Cove	8-8
8.7	I-93/I-90 Interchange And Massachusetts Avenue Interchange Area	8-8
8.8	South Boston	8-10
8.9	East Boston/Logan Airport	8-14
8.10	Land Use Impacts - Permanent Facilities	8-16
8.11	Land Use Impacts - Area North Of Causeway Street	8-18

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
8.12	View Of Mainline And Charles River Bridges	8-20
8.13	Land Use Impacts - Central Area	8-24
8.14	Plan Of Parcel 7 And Proposed Action With Surrounding Area	8-24
8.15	Aerial View Of The North End, Government Center And Haymarket	8-24
8.16	Perspective Of Financial District	8-26
8.17	Land Use Impacts - I-93/I-90 Interchange And Massachusetts Avenue Interchange Area	8-30
8.18	Perspective Of Chinatown	8-30
8.19(a)	Land Use Impacts - South Boston/South Boston Bypass Road (Northern Area)	8-32
8.19(b)	Land Use Impacts - South Boston/South Boston Bypass Road (Southern Area)	8-32
8.20	Land Use Impacts - East Boston/Logan Airport Area	8-38
8.21	Perspective Of Expanded East Boston Memorial Stadium	8-38
8.22	Illustrative Parkland Development Concept, Area North Of Causeway Street	8-40
9.1	Visual Characteristics - Area North Of Causeway Street	9-2
9.2	Visual Characteristics - Central Area	9-2
9.3	Visual Characteristics - Central Area	9-2
9.4	Visual Characteristics - Central Area	9-2
9.5	Visual Characteristics - I-93/I-90 Interchange And Massachusetts Avenue Interchange Area	9-4
9.6	Visual Characteristics - South Boston And South Boston Bypass Road Area	9-4
9.7	Visual Characteristics - East Boston/Logan Airport Area	9-6

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
9.8	Key Map Of Perspective Drawings	9-8
9.9	CANA Model And Proposed Action Model	9-8
9.10	North Station - Charles River Pedestrian Connection	9-8
9.11	View of Charles River Looking West	9-8
9.12	View of Charles River Looking East	9-8
9.13	Motorists' View From Charles River Bridge	9-10
9.14	Massachusetts Avenue And Southeast Expressway Gateway Into Central Boston	9-10
9.15	Aerial View Of Expanded East Boston Memorial Stadium	9-10
9.16	Viaduct Design And South Boston Tunnel Portal	9-12
9.17	Model Of Tunnel Interiors	9-12
9.18	Tunnel Interiors	9-12
9.19	Central Area - Haymarket	9-14
9.20	Central Area - Broad Street And Rowes Wharf Arch	9-14
9.21	Beach Street At Chinatown	9-14
9.22	Vent Buildings 1 And 2	9-16
9.23	Vent Building 3 - Boston Edison Site, Atlantic Avenue	9-16
9.24	Vent Building 6 (South Boston) And Vent Building 7 (East Boston)	9-18
10.1	Historic Resources - Central Artery/Tunnel Project	10-2
10.2	Historic Resources - Affected Properties Area North Of Causeway Street Alignment	10-8
10.3	Historic Resources - Affected Properties Central Area Alignment	10-10

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
10.4	Historic Resources - Affected Properties I-93/I-90 Interchange And Massachusetts Avenue Interchange Area Alignment	10-14
10.5	Historic Resources - Affected Properties South Boston And South Boston Bypass Road Area Alignment	10-16
10.6	New Created Parcels In The Central Area	10-16
11.1	Archaeological Test Sites	11-2
11.2	North End Archaeological Study Block	11-4
12.1	Before And After Utility Relocation Program	12-4
12.2	Schematic Plan Of Existing And Proposed Utility Network	12-4
13.1	Project Area Water Bodies	13-2
13.2	Fort Point Channel Location Map	13-2
13.3	Fort Point Channel Core Sample Locations	13-8
13.4	Inner Harbor Location Map	13-8
13.5	Tidal Excursion	13-12
13.6	Location Of Environmental Borings In Boston Inner Harbor	13-14
13.7	Polyaromatic Hydrocarbon (PAH) Sampling Stations	13-14
13.8	Location Of Charles And Millers Rivers	13-16
13.9	Millers River Sampling Stations	13-18
13.10	Major Users Of Boston Harbor Water	13-24
13.12	Locations Of Activities In The Water	13-26
13.13	Proposed And Existing Outfall Locations	13-26
13.14	Proposed Roadway Drainage Areas Schematic	13-26
13.15	Proposed Structures: Fort Point Channel	13-26

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
13.16	Plan, Profile, And Cross-Section Of Seaport Access Road And I-90 Tunnel Box	13-28
13.17	Proposed Structures And Fill: Boston Inner Harbor	13-32
13.18	Proposed Structures And Fill: Charles And Millers Rivers	13-32
13.19	Bridge Pier Locations For The Proposed Charles River Crossing	13-32
13.20	Location Of Tunnel Sections	13-34
14.1	Locations Of Activities In The Water	14-4
14.2	Location Of Charles And Millers Rivers	14-4
14.3	Water Quality Features In The Charles And Millers Rivers	14-4
14.4	Pier A - Charles River Bridge	14-4
14.5	Views Of Charles River	14-8
14.6	Views Of Millers River	14-8
14.7	Millers And Charles Rivers Inland Wetlands	14-8
14.8	Fort Point Channel Location Map	14-12
14.9	Typical Fort Point Channel Coastal Banks	14-14
14.10	Resource Areas And Sampling Locations At Fort Point Channel	14-14
14.11	Inner Harbor Location Map	14-16
14.12	Barge Navigational Channel Area	14-48
14.13	Charles And Millers River Fill: 1985 vs. 1989	14-52
14.14	Fort Point Channel Fill: 1985 vs. 1989	14-52
14.15	Boston Inner Harbor Fill: 1985 vs. 1989	14-52
15.1	Locations Of Activities In The Water	15-2
20.1	Project Structures	20-2

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
20.2	Depressed Central Artery Construction Sequence	20-2
20.3	Third Harbor Tunnel Construction Sequence	20-4
20.4	Concrete Batch Plant	20-6
20.5	Barge Loading Facility	20-6
20.6	Cross-Lot Bracing Construction Example - Downtown Seattle Transit Project	20-8
20.7	Casting Basin	20-10
20.8	Conveyor Belt Examples	20-10
20.9	Project Construction Schedule	20-10
20.10	Construction Sites (By Year)	20-10
20.11	Design Contract Packages	20-14
20.12	Construction Management Organization	20-14
20.13	Construction Management Organization - Management Consultant	20-16
20.14	Detours And Diversions - Stages 1 Thru 5 Area North Of Causeway Street	20-18
20.15	Detours And Diversions - Stage 1 Central Area	20-20
20.16	Detours And Diversions - Stages 1 And 2 Central Area	20-20
20.17	Detours And Diversions - Stages 3 Thru 5 Central Area	20-20
20.18	Detours And Diversions - Stages 1 And 2 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area	20-24

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
20.19	Detours And Diversions - Stages 3 Thru 5 I-93/I-90 Interchange And Massachusetts Avenue Interchange Area	20-24
20.20	Detours And Diversions - Stages 1 Thru 5 South Boston And South Boston Bypass Road Area	20-24
20.21	Detours And Diversions - Stages 1 Thru 6 East Boston/Logan Airport Area	20-26
20.22	Traffic Conditions Identified For Potential Mitigation	20-28
20.23	Potential Pedestrian Impact Locations	20-28
20.24	Affected Subway And Commuter Railroad Facilities	20-30
20.25	Barge Movement In Boston Harbor	20-36
20.26	Estimated Construction Spending Impacts	20-38
20.27	Construction Workforce	20-38
20.28	Average Annual Value Of Demand For Industrial Supplies Resulting From Construction	20-42
20.29	Typical Transverse Utility Corridor	20-52
20.30	Representative Sites For Construction Noise Impact Assessment	20-62
20.31	Suspended Sediments	20-74
20.32	CANA Ramp (Example Of A Temporary Ramp)	20-88
20.33	Temporary Panel Bridge	20-88
20.34	Typical Barge	20-88
20.35	Integrated Pest Management Zones And Activities	20-90
20.36	Construction Mitigation During Three Project Phases	20-94
20.37	Construction Mitigation Example	20-94
20.38	Construction Mitigation Through A Typical Main Intersection	20-94

List Of Figures - Part I (Cont.)

Figure No.	Title	After Page
20.39	Pedestrian Mitigation Example	20-96
20.40	Aerial View of Pedestrian Connection During Construction - Haymarket Area	20-96
20.41	Entrance To Construction Period Pedestrian Path - Haymarket Area	20-96

PART IIB

Figure No.	Title	After Page
1.1	Existing Environment In The Area North Of Causeway Street Without I-93 Interchange	IIB 1-6
1.2	Families Of Roadway Options	IIB 1-8
1.3	Option 5A Modified	IIB 1-16
1.4	Option S Modified	IIB 1-16
1.5	Option T Modified	IIB 1-16
1.6	Option Z Modified	IIB 1-16
1.7	Option 5A Modified, Peak Hour Volumes And Weave Analysis	IIB 1-24
1.8	Option S Modified, Peak Hour Volumes And Weave Analysis	IIB 1-24
1.9	Option T Modified, Peak Hour Volumes And Weave Analysis	IIB 1-24
1.10	Option Z Modified, Peak Hour Volumes And Weave Analysis	IIB 1-24
1.11	Area North Of Causeway Street Noise Receptor Locations	IIB 1-42
1.12	Pier Locations In Charles River, 5A Modified And S Modified	IIB 1-50
1.13	Pier Locations In Charles River, T Modified And Z Modified	IIB 1-50
1.14	Impacts To Existing And Proposed Open Space For 5A Modified, S Modified, T Modified, And Z Modified	IIB 1-56
1.15	Aerial View Of I-93/Route 1 Interchange By Option, Looking East	IIB 1-58

List Of Figures - Part IIB (Cont.)

Figure No.	Title	After Page
1.16	Aerial View Of I-93/Route 1 Interchange By Option, Looking West	IIB 1-58
1.17	Views Of I-93/Route 1 Interchange by Option, Looking East From Science Park Station	IIB 1-60
1.18	Views Of I-93/Route 1 Interchange By Option, Looking East From North Point Area, Cambridge	IIB 1-62
1.19	Views Of I-93/Route 1 Interchange By Option, Looking West From Paul Revere Landing Park, North Bank	IIB 1-62
1.20	Views Of I-93/Route 1 Interchange By Option, From Charlestown Residential Area, Looking Southwest	IIB 1-64
1.21	Relocation Impacts for 5A Modified, S Modified, T Modified and Z Modified	IIB 1-64
1.22	Location Of Test Borings In Charles River	IIB 1-76
1.23	Cofferdam Staged Construction Phase 1, Charles River Tunnel	IIB 1-78
1.24	Cofferdam Staged Construction Phase 2, Charles River Tunnel	IIB 1-78
1.25	Immersed Tube Tunnel, Charles River	IIB 1-78
1.26	Vent Building Locations for 5A Modified, S Modified, T Modified and Z Modified	IIB 1-80
1.27	General Parkland Development Objectives, Area North Of Causeway Street	IIB 1-98
1.28	Location Of Proposed Mitigation Measures, Area North Of Causeway Street	IIB 1-100
1.29	Illustrative Parkland Development Concept, North Of Causeway Street	IIB 1-100
1.30	Illustrative Millers River Relocation Development Concepts	IIB 1-100
1.31	Illustrative Development Concept At Revere Park (South Bank) And Lovejoy Wharf	IIB 1-102
2.1	South Boston Bypass Road Study Schemes	IIB 2-2
2.2	South Boston Haul Road/Bypass Road Alternatives	IIB 2-4

List Of Figures - Part IIB (Cont.)

Figure No.	Title	After Page
2.3	Location of South Boston Haul Road And Present Designated Truck Routes	IIB 2-4
2.4	Location of Sensitive Receptors for Noise	IIB 2-14
3.1	South Boston Toll Plaza	IIB 3-4
3.2	East Boston Toll Plaza	IIB 3-6
3.3	Relocation Impacts - South Boston And South Boston Bypass Road Area	IIB 3-12
3.4	Relocation Impacts - East Boston/Logan Airport Area	IIB 3-12
4.1	Project Construction Areas	IIB 4-8
4.2	Soil Sampling Zones and Selected Boring Locations	IIB 4-20
4.3	Zinc and Copper: Schematic Diagram - Subsurface Profile Soil Characterization	IIB 4-20
4.4	Arsenic: Schematic Diagram - Subsurface Profile Soil Characterization	IIB 4-20
4.5	Lead: Schematic Diagram - Subsurface Profile Soil Characterization	IIB 4-20
4.6	Mercury: Schematic Diagram - Subsurface Profile Soil Characterization	IIB 4-20
4.7	Hydrocarbon: Schematic Diagram - Subsurface Profile Soil Characterization	IIB 4-20
4.8	Quality of Fill: Schematic Diagram - Subsurface Profile	IIB 4-20
4.9	Boston Blue Clay: Schematic Diagram - Subsurface Profile Soil Characterization	IIB 4-22
4.10	Excavation Of Historic Fill At 200 State Street	IIB 4-22
4.11	Disposal Site Screening Report Sites	IIB 4-28
4.12	MWRA Service Area	IIB 4-28

List Of Figures - Part IIB (Cont.)

Figure No.	Title	After Page
4.13	Additional Sites	IIB 4-30
4.14	Massachusetts Bay Disposal Sites	IIB 4-42
4.15	Site BED10 (Bedford)	IIB 4-58
4.16	Bedford Aquatic Resource Areas	IIB 4-58
4.17	Bedford Floodplains	IIB 4-58
4.18	Bedford Vegetative Communities	IIB 4-60
4.19	Site MAL01 (Rowe Quarry)	IIB 4-62
4.20	Malden Site Location Map	IIB 4-62
4.21	Malden Vegetative Communities	IIB 4-62
4.22	Malden Floodplains	IIB 4-64
4.23	Site WEY13 (Weymouth)	IIB 4-66
4.24	Weymouth Floodplains	IIB 4-66
4.25	Weymouth Vegetative Communities	IIB 4-68
4.26	East Brookfield Site	IIB 4-70
4.27	East Brookfield Floodplains	IIB 4-70
4.28	East Brookfield Vegetative Communities	IIB 4-74
4.29	Governors Islands Flats	IIB 4-76
4.30	Hull Bay Disposal Area	IIB 4-78
4.31	Hull Site Location Map	IIB 4-78
4.32	Logan Airport North and West Sites	IIB 4-80
4.33	Logan Airport North And West Sites - Sediment, Water Quality And Biological Sampling Locations	IIB 4-80
4.34	Existing Environmental Conditions On Spectacle Island	IIB 4-84

List Of Figures - Part IIB (Cont.)

Figure No.	Title	After Page
4.35	Spectacle Island Resource Areas	IIB 4-84
4.36	Spectacle Island	IIB 4-84
4.37	Hypothesized Limits Of Sediment Contaminants	IIB 4-86
4.38	Spectacle Island Aquatic Resource Areas	IIB 4-88
4.39	Site BED10: Landfill Footprint	IIB 4-100
4.40	Site WEY13: Landfill Footprint	IIB 4-99
4.41	East Brookfield Site: Landfill Footprint	IIB 4-102
4.42	Proposed Spectacle Island Concept	IIB 4-116
4.43	Spectacle Island Concept Plan	IIB 4-116
4.44	Footprints Of Disposal Alternatives At Spectacle Island	IIB 4-148
4.45	Potential Areas For Leveling At Logan Airport	IIB 4-152

PART IIC

Figure No.	Title	After Page
1	I-93 Southbound Off-Ramp To Causeway Street Area	IIC-2
2	I-93 Northbound On-Ramp From Causeway Street Area	IIC-4
3	I-93 Southbound Off-Ramp To Government Center Area	IIC-6
4	I-93 Southbound On-Ramp From Government Center Area And On-Ramps To Callahan Tunnel	IIC-8
5	I-93 Northbound Off-Ramp To Government Center Area	IIC-12
6	I-93 Southbound Off-Ramp To Financial District	IIC-14
7	I-93 Northbound Off-Ramp To Financial District	IIC-16
8	I-93 Northbound On-Ramp From Northern Avenue	IIC-20
9	I-93 Northbound Alignment - South Station Area	IIC-22

List Of Figures - Part IIC

Figure No.	Title	After Page
10	I-93/I-90 Interchange Major Connectors	IIC-24
11	Local Street Reconstruction In I-93/I-90 Interchange	IIC-26
12	Massachusetts Avenue Interchange Area	IIC-30
13	I-90 Mainline Alignment - South Boston	IIC-32
14	Third Harbor Tunnel Alignment - South Boston	IIC-34
15	Logan Airport Interchange - East Boston	IIC-36
16	Connections To Route 1A Northbound - East Boston	IIC-40
17	Connections To MBTA Blue Line Airport Station - East Boston	IIC-42

PART IID

Figure No.	Title	After Page
1	Possible Design Refinements Under Consideration - I-93/I-90 Interchange And Massachusetts Avenue Interchange Area	IID-2
2	Possible Design Refinements Under Consideration - South Boston/South Boston Bypass Road	IID-2
3	Possible Design Refinemenets Under Consideration - East Boston/Logan Airport Area Alignment	IID-4

PART III

Figure No.	Title	After Page
1	Location Of Parkland Addressed In Section 4(f) Evaluation	III-2
2	Design Options - Area North Of Causeway Street	III-2
3	Section 4(f) Resources Area North Of Causeway Street	III-4
4	Views Of Leverett Circle And Storrow Drive	III-4
5	Use Of The Section 4(f) Resource At Leverett Circle	III-4

List Of Figures - Part III (Cont.)

Figure No.	Title	After Page
6	Views Of Paul Revere Landing Park, South Bank Of River	III-8
7	Views Of Lower Charles River	III-8
8	Use Of Section 4(f) Resource (Paul Revere Landing Park, South Bank)	III-8
9	General Parkland Development Objectives, Area North Of Causeway Street	III-18
10	Location Of Proposed Mitigation Measures, Area North Of Causeway Street	III-20
11	Illustrative Parkland Development Concept, Area North Of Causeway Street	III-20
12	Illustrative Development Concept At Revere Park (South Bank) And Lovejoy Wharf	III-20
13	Illustrative Millers River Relocation Development Concepts	III-20
14	Illustrative View Of Charles River Bridges, Proposed Action	III-20
15	Illustrative View Of Alternative Charles River Bridge Structural Types: Option 8	III-20
16	Illustrative View Of Alternative Charles River Bridge Structural Types: Option 9	III-20
17	Illustrative Improvements To Leverett Circle, Nashua Street Parcel And GSA Site	III-22
18	Existing Parkland, East Boston Memorial Stadium Park	III-22
19	Views Of East Boston Memorial Stadium Park: Facilities For Active Recreation	III-22
20	Views Of East Boston Memorial Stadium Park	III-22
21	Proposed Uses In The Area Of East Boston Memorial Stadium Park	III-24

List Of Figures - Part III (Cont.)

Figure No.	Title	After Page
22	East Boston Memorial Stadium Proposed Landscaping	III-26
23	Location Of Spectacle Island	III-28
24	Spectacle Island Resource Areas	III-28
25	Proposed Spectacle Island Concept	III-30
26	Parkland Unaffected By Proposed Action	III-30
27	Historic Resources Addressed in Section 4(f) Evaluation	III-34

List Of Tables

PART I

Table No.	Title	Page
1.1	Design Development To Resolve Outstanding Issues As Identified In The FEIS/R Process	1-2
3.1	Comparison Of 1982 And 1987/88 Average Weekday Traffic Volumes	3-5
3.2	Existing 1987/88 Traffic Conditions Highway Links	3-7
3.3	1987/88 Traffic Conditions At Signalized Intersections	3-11
3.4	1987/88 Traffic Conditions In Ramp Areas	3-13
3.5	Inflammable Materials Trucks In Selected Locations	3-18
3.6	Summary Of Existing And Projected Traffic Conditions	3-25
3.7	Existing And Projected Average Weekday Traffic Volumes	3-28
3.8	Existing And Projected Average Weekday Daily Traffic On Selected Surface Street Links	3-37
3.9	Projected Average Weekday Daily Traffic Screenline Crossings	3-40
3.10	Existing And Projected AM And PM Peak Hour Traffic Volumes	3-41
3.11	Projected Traffic Operations In 2010	3-54
3.12	Traffic Operations At Critical Ramp Areas	3-58
3.13	Projected Traffic Operations At Signalized Intersections	3-61
3.14	Comparison Of Existing And Projected VMT And VHT In Study Area	3-73
3.15	Daily Vehicle Miles Travelled (VMT) By Community And Facility Type for 2010 Build Conditions	3-75
3.16	Daily Vehicle Miles Travelled (VMT) By Community And Facility Type For 2010 No-Build Conditions	3-77
3.17	Daily Vehicle Hours Travelled (VHT) By Community And Facility Type For 2010 Build Conditions	3-79
3.18	Daily Vehicle Hours Travelled (VHT) By Community And Facility Type For 2010 No-Build Conditions	3-81

List Of Tables - Part I (Cont.)

Table No.	Title	Page
3.19	Projected Expressway Accidents And Accident Rates	3-86
3.20	Projected Systemwide Accidents And Accident Rates	3-87
3.21	Permanent Parking Displacements By Proposed Action	3-88
3.22	Comparison Of Transit And Auto Trips To Study Area And Boston Proper, 1987, 2010 Baseline, And 2010 Build	3-92
3.23	Rapid Transit Improvements: MBTA Capital Construction Program	3-100
3.24	Summary Of Estimated HOV Volumes For I-93 Between South Station And Massachusetts Avenue	3-104
4.1	National And State Ambient Air Quality Standards	4-3
4.2	Air Toxics Identified In Vehicle Exhaust	4-5
4.3	Maximum And Second-Highest Hourly Ozone Concentrations Measured In The Boston Metropolitan Area	4-8
4.4	Annual Mean, Maximum Hourly, And Second-Highest Hourly NO_2 Concentrations Measured In The Boston Metropolitan Area (ug/m^3)	4-9
4.5	Maximum And Second-Highest 1-Hour And 8-Hour CO Concentrations Measured In The Boston Metropolitan Area	4-11
4.6	Vehicular Operating Conditions	4-15
4.7	Carbon Monoxide Background Levels	4-16
4.8	Estimated 1-Hour And 8-Hour Worst Case Carbon Monoxide Levels In 1987 Based On Microscale Modeling	4-17
4.9	Traffic Parameters Used To Estimate Areawide Emission Burdens For The Year 1987	4-20
4.10	Peak Daily Emission Burdens In The Study Area 1987	4-21
4.11	Annual Emission Burdens In The Study Area 1987	4-22
4.12	Estimated 1-Hour Worst Case Carbon Monoxide Levels In 1998 With And Without The Proposed Action	4-24

List Of Tables - Part I (Cont.)

Table No.	Title	Page
4.13	Estimated 8-Hour Worst Case Carbon Monoxide Levels In 1998 With And Without The Proposed Action	4-26
4.14	Traffic Parameters Used To Estimate Areawide Emission Burdens For The Year 1998	4-29
4.15	Peak Daily Emission Burdens In The Study Area 1998	4-30
4.16	Annual Emission Burdens In The Study Area 1998	4-31
4.17	Estimated 1-Hour Worst Case Carbon Monoxide Levels In 2010 With And Without The Proposed Action	4-33
4.18	Estimated 8-Hour Worst Case Carbon Monoxide Levels In 2010 With And Without The Proposed Action	4-35
4.19	Traffic Parameters Used To Estimate Areawide Emission Burdens For The Year 2010	4-38
4.20	Peak Daily Emission Burdens In The Study Area 2010	4-39
4.21	Annual Emission Burdens In The Study Area 2010	4-40
4.22	Proposed Ventilation Building Sites	4-47
4.23	Emission Rates Used In Ventilation Building Impact Analysis	4-49
4.24	Air Quality Prediction Sites For Physical Modeling Of Ventilation Building 3: Boston Edison Site	4-51
4.25	Air Quality Prediction Sites For Physical Modeling Of Ventilation Building 4: Parcel 7	4-53
4.26	Maximum Annual Average NO_2 Concentrations At Ground Level And Elevated Receptor Locations In The Vicinity Of Proposed Ventilation Buildings Based On Analytical (ISCLT) Modeling Results	4-57
4.27	Maximum 1-Hour And 8-Hour CO Concentrations At Ground Level And Elevated Receptor Locations In The Vicinity Of Proposed Ventilation Buildings Based On Analytical (ISCST) Modeling Results	4-58

List Of Tables - Part I (Cont.)

Table No.	Title	Page
4.28	Maximum 1-Hour NO_x and NO_2 Ground Level Concentrations In The Vicinity Of Ventilation Buildings 1, 2, 5, 6, and 7 Based On The Results Of Analytical (ISCST) Modeling	4-60
4.29	Second-Highest Hourly Total NO_2 Concentrations By Wind Direction Resulting From Emissions From Ventilation Building 3, Boston Edison Site Based On The Results Of Physical Modeling	4-61
4.30	Second-Highest Hourly Total NO_2 Concentrations By Wind Direction Resulting From Emissions From Ventilation Building 4, Parcel 7 Site Based On The Results Of Physical Modeling	4-63
4.31	Maximum Predicted Ground Level Concentrations Of NO_2 And CO At All Ventilation Buildings Based On The Results Of Analytical Modeling	4-65
4.32	Maximum Predicted Concentrations Of NO_2 And CO At Elevated Receptors At All Ventilation Buildings Based On The Results Of Analytical Modeling And Wind Tunnel Studies	4-67
5.1	Federal Highway Administration Noise Abatement Criteria	5-3
5.2	Comparison Of Predicted Noise Levels With Existing Levels: Area North Of Causeway Street [in L_{eq}(1 Hour) dBA]	5-4
5.3	Comparison Of Predicted Noise Levels With Existing Levels: Central Area [in L_{eq}(1) dBA]	5-5
5.4	Comparison Of Predicted Noise Levels With Existing Levels: I-93/I-90 Interchange And Massachusetts Avenue Interchange Area [in L_{eq}(1 Hour) dBA]	5-6
5.5	Comparison Of Predicted Noise Levels With Existing Levels: South Boston/South Boston Bypass Road Area [in L_{eq}(1 Hour) dBA]	5-7
5.6	Comparison Of Predicted Noise Levels With Existing Levels: East Boston/Logan Airport Area [in L_{eq}(1 Hour) dBA]	5-8
5.7	Variation Of Hourly L_{eq} Over A 24-Hour Period At The Callahan/Sumner Tunnel Toll Plaza (Site 14)	5-10
5.8	Variation Of Hourly L_{eq} Over A 24-Hour Period At Harbor Tower Building (Site 22)	5-11

List Of Tables - Part I (Cont.)

Table No.	Title	Page
5.9	Variation Of Hourly L_{eq} Over A 24-Hour Period At Stillman And Endicott Street Residences (Site 31)	5-12
5.10	Variation Of Hourly L_{eq} Over A 24-Hour Period At Flaherty Park (Site 34)	5-13
5.11	Variation Of Hourly L_{eq} Over A 24-Hour Period At 25-31 West Fifth Street, South Boston (Site 35)	5-14
5.12	Comparison Of Predicted Noise Levels [in L_{eq}(1 Hour) dBA] With FHWA Criteria: Area North Of Causeway Street	5-17
5.13	Comparison Of Predicted Noise Levels [in L_{eq}(1 Hour) dBA] With FHWA Criteria: Central Area	5-18
5.14	Comparison Of Predicted Noise Levels [in L_{eq}(1 Hour) dBA] With FHWA Criteria: I-93/I-90 Interchange And Massachusetts Avenue Interchange Area	5-19
5.15	Comparison Of Predicted Noise Levels [in L_{eq}(1 Hour) dBA] With FHWA Criteria: South Boston/South Boston Bypass Road Area	5-20
5.16	Comparison Of Predicted Noise Levels [in L_{eq}(1 Hour) dBA] With FHWA Criteria: East Boston/Logan Airport Area	5-21
5.17	Ventilation Noise Assessment Summary	5-24
5.18	Project Vibration Criteria	5-31
5.19	Summary Of Existing Vibration Measurement	5-32
6.1	Annual Energy Consumption By Vehicles	6-2
6.2	2010 Build Condition: Annual Energy Consumption For Roadway Support Systems In Millions Of Btu	6-4
6.3	Indirect Construction Energy Consumption: 2010 Proposed Action Condition	6-4
7.1	Employment In The Boston Metropolitan Area	7-3
7.2	Study Area Land Use And Employment (1986)	7-6
7.3	Distribution Of Private Employment By Zip Codes In The City Of Boston Portion Of The Study Area	7-7

List Of Tables - Part I (Cont.)

Table No.	Title	Page
7.4	Occupants Of Offices In Downtown Boston	7-10
7.5	Mix Of Retail Sales	7-11
7.6	Mode Of Access To Shopping Districts	7-11
7.7	Annual Construction Of Industrial Facilities In Metropolitan Boston (NECMA) 1980-1988	7-14
7.8	Vacancy Rates For Metropolitan Boston Industrial Space	7-15
7.9	Manufacturing Employment In Boston 1977-1985	7-16
7.10	Year-Round Residential Units In The Study Area By Neighborhood	7-17
7.11	Visitors To Greater Boston	7-19
7.12	Purpose Of Visits To Greater Boston (1985)	7-19
7.13	Direct Expenditures By Visitors In Greater Boston (1985)	7-21
7.14	Direct Expenditures In Boston Area By Lodging Type (1985)	7-22
7.15	Tourism-Related Employment In The Boston Area (1985)	7-22
7.16	Central Area Land Use And Employment (1986)	7-24
7.17	Summary Of Long-Term Economic Impacts (Year 2010)	7-27
7.18	Suffolk County And Metro Area Employment Growth Forecasts	7-29
7.19	Study Area Land Use And Employment Forecast	7-31
7.20	Long-Term Retail Sales Impacts Due To The Artery/Tunnel Project	7-32
7.21	Projected Tourism Activity Under Baseline And Proposed Action	7-46
7.22	Total Suffolk County And Metro Employment In Year 2010	7-52
7.23	Long-Term (Year 2010) Annual Fiscal Impacts Of The Proposed Action On the Commonwealth Of Massachusetts	7-55
8.1	Major Land Use Changes Since 1983 In Area North Of Causeway Street	8-3

List Of Tables - Part I (Cont.)

Table No.	Title	Page
8.2	Major Land Use Changes Since 1983 In Central Area	8-5
8.3	Major Land Use Changes Since 1983 In I-93/I-90 Interchange And Massachusetts Avenue Interchange Area	8-9
8.4	Major Land Use Changes Since 1983 In South Boston And South Boston Bypass Road Area	8-11
8.5	Major Land Use Changes Since 1983 In East Boston/Logan Airport Area	8-13
8.6	Land Use Impacts In Area North Of Causeway Street	8-19
8.7	Land Use Impacts In Central Area	8-22
8.8	Land Use Impacts In I-93/I-90 Interchange and Massachusetts Avenue Interchange Area	8-28
8.9	Land Use Impacts in South Boston/South Boston Bypass Road Area	8-33
8.10	Land Use Impacts On Massport Property	8-35
8.11	Land Use Impacts On EDIC Property	8-36
8.12	Land Ownership In East Boston/Logan Airport Right-of-Way	8-38
10.1	Status Of Historic Resources In The Vicinity Of The Artery/ Tunnel Project	10-2
10.2	New Parcels Subject To Joint Development Design Guidelines For Historic Preservation	10-6
12.1	Miles Of Major Utility Relocations By Subarea	12-3
13.1	Commonwealth Of Massachusetts Water Quality Standards	13-3
13.2	Existing Water Quality In Fort Point Channel	13-6
13.3	Fort Point Channel Sediment Analysis	13-9
13.4	Benthic Organisms In Project Right-Of-Way In Fort Point Channel	13-10
13.5	Existing Water Quality In Boston Inner Harbor	13-12

List Of Tables - Part I (Cont.)

Table No.	Title	Page
13.6	Bulk Sediment Characteristics Near The Third Harbor Tunnel Alignment	13-14
13.7	Polyaromatic Hydrocarbon Concentrations In The Third Harbor Tunnel Alignment	13-15
13.8	Existing Water Quality In Lower Charles River	13-18
13.9	Summary Of Measurement Of Millers River Water Quality Parameters	13-19
13.10	Dissolved Oxygen And Temperature Measurements In The Millers River	13-20
13.11	Lower Charles River Sediment Analysis	13-21
13.12	Millers River Sediment Quality	13-22
13.13	Industrial Seawater Use In The Boston Harbor Area	13-24
14.1	Constraints To Navigation In Fort Point Channel And Charles River	14-9
14.2	Major Existing Piers And Berths In The Vicinity Of Project Activities	14-10
14.3	Industrial Seawater Use In The Boston Harbor Area	14-17
14.4	Species List Of Boston Inner Harbor Marine Benthic Macroinvertebrates	14-20
14.5	Boston Inner And Outer Harbor Finfish Species List	14-22
14.6	Functional Evaluation Summary	14-25
14.7	Criteria For Functions And Values Assessment	14-26
14.8	Artery/Tunnel Projectwide Fill Volumes And Areas 1985 FEIS/R And 1989 SEIS/R	14-31
14.9	Proponent's Factual Determination: Millers River (Nontidal)	14-35
14.10	Proponent's Factual Determination: Charles River (Nontidal)	14-36
14.11	Proponent's Factual Determination: Fort Point Channel	14-44

List Of Tables - Part I (Cont.)

Table No.	Title	Page
14.12	Proponent's Factual Determination: Boston Inner Harbor	14-50
18.1	Relationship Of The Proposed Action To Other Projects	18-3
20.1	Summary Of Economic Impacts Of Construction	20-37
20.2	Expenditures On Labor, Materials, And Equipment	20-39
20.3	Direct, Indirect, And Induced Impacts On Sales And Jobs In Suffolk County	20-40
20.4	Direct, Indirect, And Induced Impacts On Sales And Jobs In The Region	20-41
20.5	Estimated Local Impacts For Establishments Adjacent To The Central Artery	20-45
20.6	Construction Phase Annual Fiscal Impacts: Commonwealth Of Massachusetts	20-47
20.7	Truck Requirements By Subarea	20-56
20.8	Background TSP Levels For Concrete Batch Plant	20-58
20.9	Gaseous Emission Rates For Concrete Batch Plant	20-60
20.10	Typical Noise Levels From Construction Equipment	20-62
20.11	Maximum Predicted Construction Noise Levels	20-64
20.12	Criteria For Annoyance Due To Groundborne Vibration In Buildings	20-66
20.13	Typical Vibration Levels Due To Construction Equipment And Traffic At 100-Foot Distance	20-68
20.14	Historic Buildings And Structures Within 110 Feet Of Pile Driving Activities	20-71
20.15	Nonhistoric Buildings Within 60 Feet Of Pile Driving Activities	20-72

List Of Tables - Part IIB

PART IIB

Table No.	Title	Page
1.1	Artery/Tunnel Project Design Criteria	IIB 1-5
1.2	Summary Of Advantages And Disadvantages Of The Options	IIB 1-25
1.3	Traffic Operations Summary	IIB 1-27
1.4	Weaving Section Level Of Service Summaries	IIB 1-28
1.5	Highway Ramp Junction Operations - Mainline Volume And Lane 1 Volume At Merge (PCPH)	IIB 1-29
1.6	Summary Of Intersection Operations	IIB 1-30
1.7	Peak Hour Traffic Operations At The Intersection Of Causeway Street And Surface Artery	IIB 1-31
1.8	Estimated Peak Hour Travel Times And Speeds On Mainline	IIB 1-32
1.9	Estimated Peak Hour Travel Times And Speeds On Leverett Circle/Storrow Drive Connectors	IIB 1-33
1.10	Estimated Queues And Queue Speeds	IIB 1-34
1.11	Comparison Of VHT And VMT Measures (Entire Project Study Area)	IIB 1-35
1.12	Comparison Of VHT And VMT Measures (Downtown And Area North Of Causeway Street Districts)	IIB 1-35
1.13	Annual Air Quality Emissions Burden For Carbon Monoxide (Tons Per Year) Year: 2010	IIB 1-38
1.14	Annual Air Quality Emissions Burden For Hydrocarbons (Tons Per Year) Year: 2010	IIB 1-39
1.15	Annual Air Quality Emissions Burden For Nitrogen Oxides (Tons Per Year) Year: 2010	IIB 1-40
1.16	Predicted Worst-Case 8-Hour Carbon Monoxide Levels In Year 2010 For The Four Options North Of Causeway Street	IIB 1-42
1.17	Factors Resulting In Aquatic Impacts	IIB 1-46

List Of Tables - Part IIB (Cont.)

Table No.	Title	Page
1.18	Open Space And Parkland Summary Of Long-Term Impacts By Option	IIB 1-54
1.19	Relocations Required In The Area North Of Causeway Street	IIB 1-64
1.20	Comparison Of Roadway Characteristics By Roadway Link	IIB 1-84
1.21	Comparison Of Traffic Operations	IIB 1-86
1.22	Comparison Of Long-Term Environmental Impacts	IIB 1-88
1.23	Comparison Of Construction Period Impacts	IIB 1-91
1.24	Evaluation Of Options Relative To Design Objectives	IIB 1-93
2.1	Comparative Volumes On Selected Highway Links	IIB 2-8
2.2	Weaving Analysis	IIB 2-10
2.3	Intersection Level of Service Andrew Square Approaches	IIB 2-11
2.4	I-93/I-90 Ramp Connections	IIB 2-13
2.5	Predicted Worst Case 1-Hour Carbon Monoxide Levels In 2010	IIB 2-15
2.6	Predicted Worst Case 8-Hour Carbon Monoxide Levels In 2010	IIB 2-16
2.7	Annual Air Quality Emissions Burden for South Boston in Year 2010	IIB 2-17
2.8	Peak Hour Noise Levels At Locations Affected By The South Boston Bypass Road Alternatives	IIB 2-18
3.1	Estimated Average Westbound Traffic Speeds (MPH) In PM Peak Hour, Year 2010	IIB 3-8
3.2	Predicted Worst-Case 8-Hour Carbon Monoxide Levels Under Each Toll Plaza Alternative	IIB 3-11
4.1	Comparison Of Methods And Materials Movement Options By Construction Area	IIB 4-12
4.2	Materials Quantities By Construction Area	IIB 4-17

List Of Tables - Part IIB (Cont.)

Table No.	Title	Page
4.3	Classification Of Material By Chemical Constituents	IIB 4-18
4.4	Summary Of Statistical Analysis Of Selected Soil Constituents	IIB 4-20
4.5	Estimated Composition of Fill Materials	IIB 4-23
4.6	Disposal Site Screening Report Sites	IIB 4-29
4.7	Practicability Screening Criteria	IIB 4-33
4.8	Active Coastal Landfills	IIB 4-39
4.9	Disposal Site Screening Summary	IIB 4-51
4.10	DEP Solid Waste Landfill Siting Criteria	IIB 4-53
4.11	Summary Of Potential Materials Disposal Sites That Met Initial Screening Criteria	IIB 4-56
4.12	Potential Aquatic Impacts For Proposed Spectacle Island	IIB 4-122
4.13	Summary of Initial Impacts On Combined Aquatic Resource Areas	IIB 4-128
4.14	Aquatic Resource Area Impacts In Potential Disposal Sites	IIB 4-137
4.15	Comparison Of Resulting Conditions Associated With Various Spectacle Island Approaches	IIB 4-138
4.16	Comparison Of Net Impacts Associated With Various Spectacle Island Approaches	IIB 4-139
4.17	Summary Of Direct Impacts To Environmental Conditions Of Potential Disposal Sites	IIB 4-142
4.18	Composite Of Disposal Sites/Impacts	IIB 4-148

PART III

Table No.	Title	Page
2.1	Section 4(f) Parkland Impact Summary Area North Of Causeway Street	III-14

Chapter 10 – Historic Resources

Chapter 10
HISTORIC RESOURCES

This chapter features an update of the inventory of historic resources in the vicinity of the Proposed Action, originally prepared during the period 1982-83 as part of the process leading to the FEIS/R.

On April 11, 1984, a Memorandum of Agreement (MOA) for the Artery/Tunnel Project was signed by FHWA, the Massachusetts State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation (Advisory Council) pursuant to the National Historic Preservation Act and its implementing regulations. The Boston Landmarks Commission (BLC) and the Massachusetts Department of Public Works (the Department) also signed the agreement. This memorandum was included in the FEIS/R, and it addressed mitigation of adverse effects to historic resources.

The Department and FHWA have updated the inventory as part of this SEIS/R. The findings of this more recent inventory are described in Section 10.1.

Section 10.2 of this chapter also updates the FEIS/R analysis regarding the potential effects of the Proposed Action on historic resources. Newly identified potential effects are presented and discussed. Where effects to historic resources have been identified as adverse, measures to mitigate such effects also are recommended in Section 10.2.

The chapter concludes with a comparison of potential effects of the Proposed Action with impacts identified in the FEIS/R.

10.1 AFFECTED ENVIRONMENT

Table 10.1 summarizes the current status of all historic properties and districts in the project area, including those listed on the National Register of Historic Places (NR), determined eligible to be listed by the Keeper of the National Register (NRDOE), or considered by concurrence of FHWA and the SHPO to be eligible (NRE) for listing. These designations provide equal protection under Section 106 of the National Historic Preservation Act of 1966 (36 CFR Part 800). (Figure 10.1 shows the location of these resources.) Changes since 1982 in the status of previously identified resources are noted by an asterisk. Newly surveyed structures identified during the SEIS/R process appear at the end of the table. Agreement regarding National Register eligibility of these resources has been made by the SHPO and FHWA in consultation with the BLC.

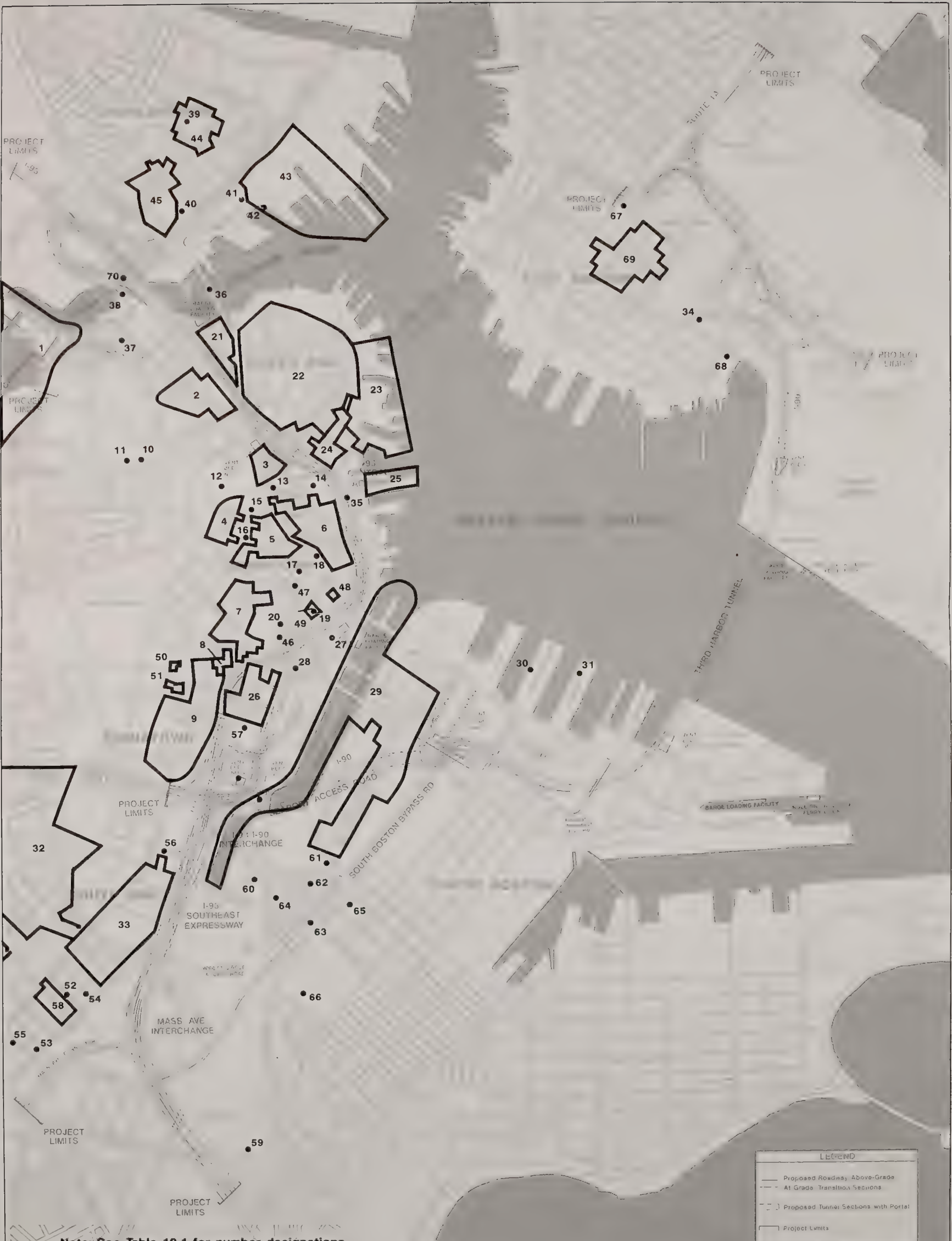
The study corridor for the 1988 inventory of historic resources is similar to that used in 1982. It encompasses an area that could be subject to any potential effects, such as physical destruction, damage, or alteration that may occur during construction and operations of the project, as well as potential visual impacts. These direct effects were disclosed in the consultation conducted in 1984, and mitigating measures were stipulated in the MOA.

Because of Boston's irregular street pattern, topography, and historical development patterns, and the location of such visual elements as the proposed ventilation buildings,

Table 10.1

STATUS OF HISTORIC RESOURCES IN THE VICINITY OF THE ARTERY/TUNNEL PROJECT

No.	Property/District	Status	Type of Effect
Previously Identified Resources:			
1	Charles River Basin District	NR	NAE**
2	Bulfinch Triangle District	NR*	AE**
3	Blackstone Block District	NR	AE**
4	Cornhill District	NRE	NE
5	Exchange District	NRE	NE
6	Custom House District	NR	AE
7	Commercial Palace District	NRDOE*	NE
8	Essex/Kingston Textile District	NRE	NAE**
9	Chinatown District	NRE	AE
10	Old West Church	NR, NHL	NE
11	First Harrison G. Otis House	NHL	NE
12	Old Boston City Hall	NRE	NE
13	Faneuil Hall	NR & NHL	NAE**
14	Faneuil Hall Market Place	NR & NHL	AE
15	Old State House	NR, NHL	NE
16	Carter Winthrop Building	NR	NE
17	(Former) Federal Reserve Bank, 22-42 Pearl Street	NRDOE*	NE
18	272-276 Franklin Street	NRE	NE
19	Richardson Block	NR*	NAE
20	34-66 High Street	NR	NE
21	Causeway/N. Washington Streets District	NRE	AE**
22	North End District	NRE	AE
23	Old Waterfront District	NRE	NE
24	Fulton/Commercial Streets District	NR	AE
25	Long Wharf District	NR	NE
26	Leather District	NR*	AE**
27	Russia Wharf	NR	AE
28	South Station Headhouse	NR	AE**
29	Fort Point Channel District	NRE	AE**
30	Commonwealth Pier	NR	NE
31	Fish Pier	NRE	NE
32	South End District	NR	NE
33	South End Industrial District (Expansion of Albany Street Area)	NRE	AE**
34	Butler Aviation Hangar	Demolished	--
35	Streetcar Tunnel	NRE	AE
36	Charlestown Bridge (N. Washington Street Bridge)	NRDOE	NE
Newly Inventoried Resources:			
37	100 Nashua Street	NRE	AE**
38	Charles River RR Draw 1	NRE	NE
39	Bunker Hill Monument	NR & NHL	NE
40	15-18 City Square	NR	NE
41	Hoosac Stores	NR	NE



Note: See Table 10.1 for number designations

FIGURE 10.1 **Historic Resources - Central Artery/Tunnel Project**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 10.1 (Cont.)

STATUS OF HISTORIC RESOURCES IN THE VICINITY OF THE ARTERY/TUNNEL PROJECT

No.	Property/District	Status	Type of Effect
42	USS Constitution	NR	NE
43	Charlestown Navy Yard District	NR & NHL	NE
44	Monument Square District	NR	NE
45	Town Hill District	NR	NE
46	172-180 Federal Street	NRE	NE
47	185 Franklin Street	NRE	NE
48	Oliver/Purchase Street District	NRE	AE**
49	Gridley Street District	NRE	AE**
50	Liberty Tree District	NR	NE
51	Beach/Knapp District	NR	NE
52	Lawrence Model Houses	NR	NE
53	Massachusetts Homeopathic Hospital	NRE	NE
54	575 Albany Street	NRE	NE
55	Boston City Hospital, Gridley Bryant Pavilions	NRE	NE
56	Summerfield Warehouse	NRE	NE
57	155 Kneeland Street	NRE	NE
58	East Brookline Street District	NRE	NE
59	27-29 Dexter Street	NRE	NE
60	135-137 Dorchester Avenue	NRE	NE
61	U.S. Post Office Garage	NR	NE
62	87-97 A Street	NRE	NE
63	92-94 B Street	NRE	NE
64	45, 55-59 W. Broadway	NRE	NE
65	161-167 W. 2nd Street	NRE	NE
66	St. Peter's Lithuanian Church	NRE	NE
67	156-200 Porter Street	NRE	NE
68	399 Maverick Street	NRE	NE
69	Cottage Street Area	NRE	NE
70	Tower A	NRE	AE**

---

1. The identification numbers correspond to those in Figure 10.1
2. AE = Potential Adverse Effect
3. NAE = No Potential Adverse Effect
4. NE = No Effect
5. NR = Listed on the National Register of Historic Places
6. NRDOE = Determined eligible for listing by the Keeper of the National Register
7. NRE = Eligible for listing on the National Register, by agreement of the SHPO and FHWA
8. NHL = National Historic Landmark
9. * = status has changed since the FEIS/R
10. ** = effect has changed or is new since FEIS/R
11. The Chinatown and South End Industrial Districts (former Albany Street District) were identified in the FEIS/R, and have been more fully inventoried for the SEIS/R updated survey

Source: Bechtel/Parsons Brinckerhoff

the width of the corridor varies in different areas. (For a complete list of contributing buildings in historic districts and details of status changes, refer to the Historic Resources Appendix.)

10.2 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

The criteria of Effect and Adverse Effect of the Advisory Council were used as the basis for the analysis of potential effects on historic resources in both the FEIS/R and this document. Of the 69 National Register listed or eligible historic districts and individual resources within the study corridor, the Proposed Action will have no effect on 47 of these. (Table 10.1 also lists the potential effects to each district or individual resource.) Of the remaining 23 historic districts and properties, the Proposed Action will have no adverse effect on four districts or properties and would have the potential for adverse effect to 18 districts or properties. One historic resource identified in the FEIS/R, the Butler Aviation Pavilion, has been demolished since 1985 and therefore was eliminated from the effect analysis.

Historic resources potentially affected by the Proposed Action are shown on Figures 10.2 through 10.5, and described individually in this section. They are categorized as defined in the Advisory Council criteria: No Adverse Effect ("Where there could be an effect, but the effect would not be harmful to those characteristics that qualify the property for inclusion in the National Register"), or Adverse Effect ("There could be an effect and that effect could diminish the integrity of such characteristics").

Effects to historic resources were characterized as construction period effects and long-term effects consistent with the FEIS/R. Construction period effects would be demolition, damage or alteration to structures caused by vibration, ground movement, or changes in groundwater tables. These potential adverse effects were identified in the FEIS/R. The mitigating measures stipulated for these effects were contained in the Memorandum of Agreement, #1 and #4 as follows:

- o Historic American Building Survey (HABS)/Historic American Engineering Record (HAER) Recording: If the project will directly affect historic structures through demolition or alteration, HABS or HAER level of documentation is required before such action can take place. The Old Colony Railroad Bridge, Fort Point Channel, the Summer Street bridge, the Charles River Building (including the Hoffman Building), and the Stop & Shop Building were specified for such documentation in 1984 based on proposed alteration or demolition. The Proposed Action avoids these potential impacts to the Summer Street bridge and the Charles River Building.

- o Review of Design and Construction Specifications: This stipulation requires the appointment of an independent Project Conservator to review impacts on historic resources, mitigation measures, final design, and construction specifications. The Project Conservator was appointed by and has been under contract to the Massachusetts Department of Public Works since 1988. Continual coordination will be maintained with the SHPO's office and BLC.

The Project Conservator was appointed in July 1988 and has produced a preliminary technical report entitled Preliminary Report of the Project Conservator: Potential Construction

Period Effects to Historic Resources, McGinley Hart Associates, December 1988. For that report the Project Conservator performed preliminary architectural, historical, structural, and geotechnical analyses of the historic structures including those within historic districts which could be impacted by construction. The Project Conservator will continue to evaluate historic structures and to review design specifications and construction specifications throughout the design and construction phases.

Long-term effects would be impacts to historic structures and districts occurring as a result of project design elements. As identified in the FEIS/R, because much of the Proposed Action is underground structure, many of the potential long-term effects are positive effects from the removal of the elevated Artery. Portions of the Proposed Action which have the long-term potential for adverse effects to historic resources are the location and design of ventilation structures and viaduct structures and future joint development over the underground portions of the project in and adjacent to historic areas. Changes in these effects since 1985 are discussed below. The MOA includes stipulations which would insure mitigation of adverse effects from the design of Proposed Action elements and future development over the underground structure. For each historic resource to which potential adverse effects have been identified, specific measures to mitigate such effects also are described below. The basis of these recommendations is the set of mitigating measures stipulated in the MOA which is still valid (see appendix for full text). The stipulations are, in summary:

- o Fort Point Channel Design Development Guidelines: FHWA will require that design and location of the ventilation buildings be compatible with the historic properties nearby, and that portions of the Channel's granite bulkheads affected by construction of the new I-90 tunnel be reconstructed in a manner compatible with the existing bulkhead.

- o Stop & Shop Bakery Loading Dock Relocation: The Proposed Action does not require demolition of the loading dock associated with the Stop & Shop Building.

- o Joint Development Design Guidelines: Guidelines sensitive to nearby historic properties will be prepared to provide design parameters and propose methods of implementation for the joint development areas created at those locations where the Central Artery or other portions of the transportation system will be underground. The guidelines will be reviewed and approved by the SHPO in consultation with the BLC, and completed prior to highway construction.

The "joint development" process was an unresolved issue in the FEIS/R for the Artery/Tunnel Project. The Joint Development Appendix provides further definition of the process since the FEIS/R. Historic preservation concerns related to the potential impacts of parcelization and new street patterns on the integrity of historic districts will be addressed through joint development guidelines drafted by the Department and reviewed and approved by the SHPO's office and BLC. Historic districts which will be the subject of these guidelines are listed in Table 10.2 by new parcels which are shown on Figure 10.6.

The new potential effects to historic resources are described in geographic order, generally from north to south and west to east:

Table 10.2

NEW PARCELS SUBJECT TO JOINT DEVELOPMENT DESIGN GUIDELINES FOR HISTORIC PRESERVATION

New Parcel	Potentially Affected Historic District
1	Causeway/North Washington Streets Bulfinch Triangle
2	Causeway/North Washington Streets Bulfinch Triangle North End
3	Causeway/North Washington Streets North End
4	North End
5	North End
6	North End
7	Blackstone Block North End
8	North End Blackstone Block
9	Blackstone Block North End
10	Blackstone Block North End
11	North End
12	North End Fulton/Commercial Streets
13	Fulton/Commercial Streets
14	Custom House
15	Custom House

Table 10.2 (Cont.)

NEW PARCELS SUBJECT TO JOINT DEVELOPMENT DESIGN GUIDELINES FOR HISTORIC PRESERVATION

New Parcel	Potentially Affected Historic District
16	Custom House
17	Custom House
18	Custom House
19	Gridley Street Russia Wharf
20	Russia Wharf Fort Point Channel
21	Gridley Street Russia Wharf
22	Russia Wharf Gridley Street South Station
23	Chinatown

Source: Bechtel/Parsons Brinckerhoff

Area North Of Causeway Street (See Figure 10.2).
Tower A (70): Tower A is located at the B&M tracks on the north side of the Charles River. It is historically significant as a surviving example of railroad architecture, and also for its technologically advanced signal system. The structure was built between 1928 and 1932, and continues to function as the track's signal tower. However, Tower A has been scheduled for demolition as part of the Central Artery North Area (CANA) Project, because it will no longer be able to perform signal functions as a result of that project. One of the viaducts of the CANA project will be placed directly over the structure, and supporting columns will obstruct the vital sight lines between the tower and North Station across the Charles River, thus altering the property's setting and eliminating its historic functions. The MBTA plans to move these functions into new structures and demolish Tower A.

These are impacts caused by another project and not the Proposed Action, but the MBTA and the SHPO agreed to consider the tower as National Register eligible this year, after the CANA project was underway. Sale and reuse of the structure as a railroad signal tower elsewhere is not likely since this technology, while advanced when the tower was first built, has since been replaced with modern electronic mechanisms. It has been agreed in consultation with the SHPO's office, BLC, and FHWA that the Department will document Tower A according to HABS/HAER requirements prior to demolition.

Charles River Basin District (1): The Charles River Basin National Register District incorporates the Charles River Basin and the parkways and landscaped areas on both banks for approximately 6 miles upstream from the Charles River dam to the Eliot Bridge in Cambridge.

Reconfirmation of the northeast terminus of Storrow Drive (Embankment Road) at Leverett Circle and the construction of an eastbound traffic tunnel connecting to I-93 will permanently move the southeast curb line of Storrow Drive 20 feet further southeast, resulting in a wider roadway. This edge of Storrow Drive and Leverett Circle will be affected by temporary construction easements. Construction of the eastbound tunnel will have a positive effect on this corner of the district by alleviating the present traffic problems and improving the ambience of the area. In addition, the reconfiguration will remove the traffic rotary at Leverett Circle and create a larger landscaped area, but will not directly affect the historic Street Railway Viaduct at Leverett Circle. This landscaped area will be visually consistent with the remainder of the Charles River Basin [see Section 4(f) Evaluation]. These design refinements, incorporated in the Proposed Action, will relieve traffic congestion in this part of the district.

The Proposed Action will have no adverse effect on any significant historic components of the Charles River Basin Historic District.

100 Nashua Street (37): 100 Nashua Street is an eight-story public office building designed by Edward I. P. Graham. The 1932 building of cast stone with aluminum spandrels is an impressive example of Depression-era public architecture and is significant for its distinctive design characteristic of that period.

The construction of the eastbound tunnel at Leverett Circle would require sheet pile driving within 30 feet of 100 Nashua Street. This potentially adverse effect would be mitigated through design and construction specifications, which will be subject to the Project Conservator's review.

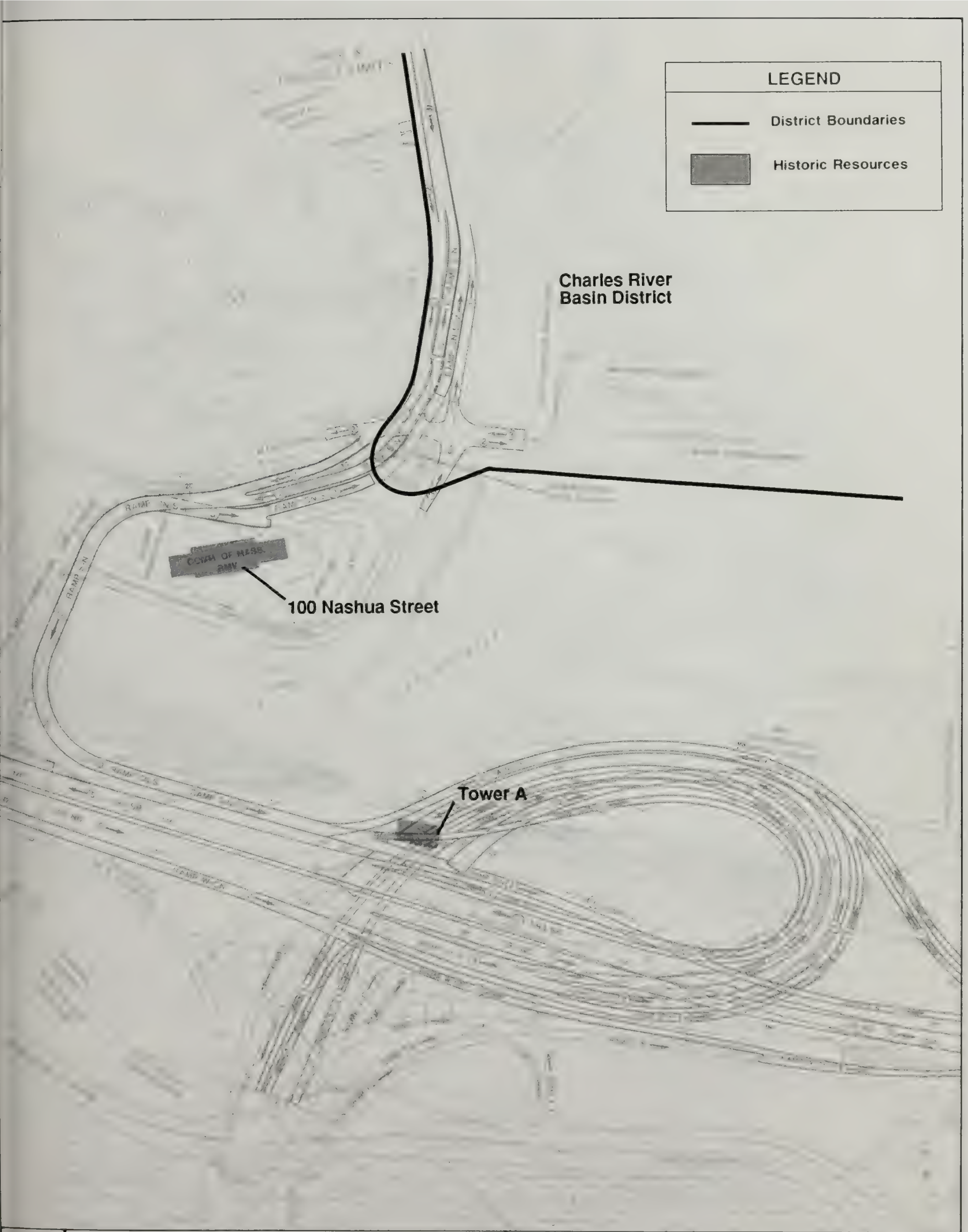


FIGURE 10.2

Historic Resources - Affected Properties Area North Of Causeway Street Alignment

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Central Area (See Figure 10.3).
Causeway/North Washington Streets District (21): The Causeway/North Washington Streets Historic District is considered eligible for listing on the National Register. The district comprises late 19th and early 20th century five- to seven-story brick buildings, having notable brick, stone, and metal detailing. The district is the eastern half of the original Bulfinch Triangle laid out by Charles Bulfinch in 1808; it is located between the elevated Central Artery and North Washington Street. The western half of the Triangle is west of the Central Artery viaduct and is listed on the National Register of Historic Places as the Bulfinch Triangle National Register District.

The Proposed Action will have the long-term positive effect of removing the Central Artery viaduct which separates the two historic portions of the Bulfinch Triangle and would visually reconnect these two historic areas. Joint development Parcels 1, 2, and 3 are located between the Causeway/North Washington Streets District and the Bulfinch Triangle District (see Figure 10.6). Joint development historic preservation guidelines developed by the Department will insure that parcelization and new street design would not adversely affect the integrity of either district and respect as feasible the historic connection of the two districts. In addition, design of the northbound I-93 ramp beginning at Traverse Street and passing under Causeway Street will lessen traffic congestion in that area.

The adverse effect of partial demolition (100 feet) of the Charles River/Hoffman Building disclosed in the FEIS/R has been eliminated through design modifications. Other potential construction period effects of the Proposed Action which could be potentially adverse to historic structures in this district will continue to be mitigated through design and construction specifications reviewed by the Project Conservator.

Bulfinch Triangle (2): The Bulfinch Triangle National Register District encompasses the eastern portion of the original Bulfinch Triangle street pattern. The architecture is diverse with the most distinctive structural type generally being the four- to six-story late 19th century brick warehouses.

This district would experience the same positive visual impacts from the Proposed Action as the Causeway/North Washington Streets District, described above. Removal of the elevated Central Artery would visually reunite the two districts on either side, especially along Causeway Street.

Based on preliminary studies conducted by the Project Conservator, construction of the Proposed Action could potentially adversely affect historic structures in this district. These potential effects will be mitigated through design and construction specifications reviewed by the Project Conservator.

Blackstone Block District (3): The Blackstone Block contains most of Boston's few remaining Colonial period buildings and streets and is listed on the National Register of Historic Places.

The Proposed Action has the potential to affect the Blackstone Block District along its east side during the construction of an underground Central Artery and the demolition of the existing viaduct, and on its north side by the construction and development of the ventilation building 4/garage/market building on Parcel 7.

Potentially adverse effects to historic structures within the Blackstone Block District may occur during construction of the southbound tunnel and ramps, 70 feet east of the district, and the foundation excavation for the ventilation structure. These potentially adverse effects would be mitigated through review of design and construction specifications by the Project Conservator.

Long-term effects to the Blackstone Block are likely to be beneficial. One of the most important aspects of historic significance of the Blackstone Block, as defined by the BLC designation and the National Register nomination, is the existence within the block of the only remaining network of 17th century streets in Boston. This network's connection to the North End is broken by the existing Central Artery viaduct. Removal of the viaduct would reestablish the visual connection and the context of the historic connector streets, Hanover and North.

Joint development Parcels 7 (discussed below), 8, 9, 10, and 11 present the opportunity to relink the historically connected Blackstone Block and North End Districts physically as well as visually. Joint development historic preservation guidelines developed by the Department will be reviewed and approved by the SHPO's office and BLC. These will insure that parcelization and changes in street patterns will not adversely affect the historic integrity of either district.

The new ventilation/parking/market structure could have potentially adverse effects on the historic block because of its scale and visual intrusion. The Blackstone Block is characterized by a mix of small 18th to 19th century structures ranging in height from two to five stories. The proposed mixed use building would be the equivalent of approximately eight stories in height (80 feet high and 42 feet high along Congress Street), having two stack forms (containing a total of 14 stacks) that would reach 125 feet high.

Mitigating measures to reduce the effects of the stack height and potential visual intrusion of the building include:

- Design specifications which minimize visual intrusion through appropriate massing and use of materials sympathetic to the historic character of the area. These specifications will be reviewed by the SHPO, the BLC, and the Project Conservator.

- Joint development of the ground floor space such as a food market, which would not adversely affect the viability of the Blackstone Block. The BLC Landmark designation specifically highlights the significance of market activity at the edges of the Blackstone Block. The SHPO's office and BLC will be part of the joint development review team for Parcel 7 (see Joint Development Appendix for other participants).

North End District (22): The North End District is considered eligible for listing on the National Register. It is Boston's oldest continuous residential neighborhood, first settled in the 1630s.

A 70-foot-wide preservation easement exists over Parcel 7, limiting the height of buildings to 42 feet to protect the vista of the Old North Church from City Hall Plaza. Design of the garage/ventilation structure at Parcel 7 respects this easement.

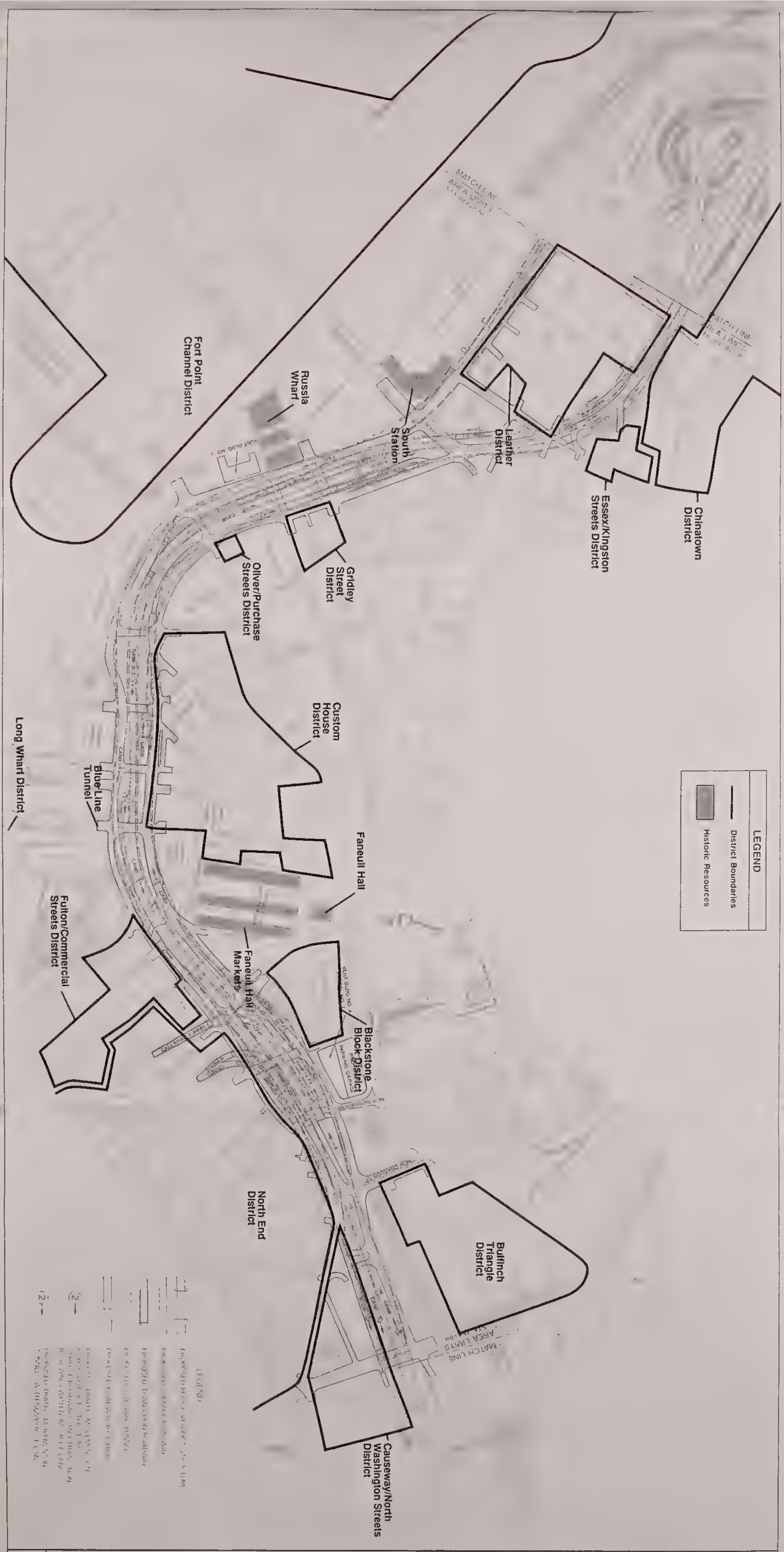


FIGURE
10.3
Historic Resources - Affected Properties Central Area Alignment

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

As stated in the FEIS/R, potential construction period effects to structures in this district will be mitigated through design and construction specifications reviewed by the Project Conservator. Potential adverse effects of joint development (Parcels 4, 5, 6, 8, 9, 10, 11, and 12) would be mitigated through historic preservation guidelines as discussed under Blackstone Block District.

Fulton/Commercial Streets District (24): This National Register district abuts the North End District to the south. It is one of the last remnants of Boston's 19th century waterfront, comprised of a unique variety of commercial architecture dating from the 1830s and 1860s.

As is the case with the visual reconnection of the North End to the rest of the City, the Fulton/Commercial Streets District also will benefit from the removal of the adjacent elevated Central Artery. The important visual relationship with the Faneuil Hall Market Place and Blackstone Block would be restored, and pedestrian access between them would be improved. Potential adverse effects to the historic integrity of this district due to joint development will be mitigated by preparation of historic preservation guidelines reviewed and approved by the SHPO's office and BLC.

In the Proposed Action, Ramp CN-SA is located closer to this district. The potential adverse effects of construction to historic buildings in this district would be mitigated through design and construction specifications reviewed by the Project Conservator.

Faneuil Hall (13): Faneuil Hall, a National Historic Landmark and listed on the National Register, is a rare example of Early Georgian public architecture.

The Proposed Action will have no adverse effect on Faneuil Hall due to the structure's distance from the proposed construction. Like the other historic resources in the Central Area, it will benefit visually from the elevated Artery's removal, and the historic connection to the waterfront will be reestablished.

Streetcar Tunnel (35): The MBTA Blue Line tunnel from Boston to East Boston was built in 1904. It is the second oldest underwater vehicular tunnel in North America.

The proposed Central Artery structure will cross above the existing Blue Line subway tunnel at State Street, immediately west of the Aquarium station. Due to the vertical clearance constraint, the bottom of the proposed Central Artery structure will be approximately 6 inches above the crown of the Blue Line tunnel.

Construction of the Proposed Action could potentially cause vibration-related structural damage to the historic tunnel. To minimize the possibility of any adverse effect, the structure will be provided with special underpinning or lateral support. The specifications for these special measures will be reviewed by the Project Conservator.

Long Wharf District (25): The original 800-foot Long Wharf (built between 1710 and 1721) was Boston's busiest pier for decades. The pier was extended to almost 0.5 mile in length in 1740, and substantially reconstructed in 1857.

The removal of the Artery would have the positive effect of visually reuniting this National Register waterfront district with the Custom House District on State Street. The contributing pier buildings are, at their closest, over 500 feet east of the Central Artery and will suffer no adverse effect. The Proposed Action will have no adverse effect on the Long Wharf District.

Custom House District (6): This National Register historic district is significant as one of the City's first examples of urban planning. In the early 19th century, under the direction of the architect, Charles Bulfinch, the area was redeveloped with wide streets, Federal-style warehouses and several monumental structures associated with Boston's maritime and commercial history.

The Proposed Action would have a long-term positive effect on the district; it will be visually reconnected with the Long Wharf District. Since it is currently adjacent to the Artery, the district will, in the future, border on joint development Parcels 15, 16, and 17 that will be planned using historic preservation guidelines as stipulated in the MOA. State, Milk, and India Streets will extend across the joint development area, offering an opportunity to physically reconnect the district to the waterfront and improve pedestrian access between the two areas. The guidelines will insure that parcelization and new street patterns do not adversely affect the district.

As stated in the FEIS/R, potential adverse effects to historic structures during construction will be mitigated through design and construction specifications reviewed by the Project Conservator. The Proposed Action also contains a utility relocation corridor through the foundation of 109-133 Broad Street. Specifications designed to protect the historic integrity of that structure will be reviewed by the Project Conservator.

Oliver/Purchase Streets District (48): This small district of structures, constructed after the great fire of 1872, is notable for the harmony of scale, materials, and design, as well as the generally intact quality of the two buildings, particularly at the storefront level.

Like the other Central Business District historic resources, this small district also would benefit from the removal of the elevated Artery: the district would be visually reconnected with the waterfront.

Potential construction-related adverse effects to these structures will be mitigated through design and construction specifications reviewed by the Project Conservator.

Gridley Street District (49): This National Register eligible district encompasses an intact group of commercial buildings, including a post-fire Neo-Greco mercantile block, a Richardsonian Romanesque commercial building, and a 1930 Art Deco office building. Within the district is the National Register listed Richardson Block (19), at 113-117 and 121-151 Pearl Street.

This district borders a potential joint development area (#21) of the Artery/Tunnel Project. In addition, ventilation building 3 will be located on Atlantic Avenue at the Boston Edison site. As stipulated in the MOA, joint development design guidelines for parcels and ventilation buildings affecting these properties will be developed in consultation with the SHPO, BLC, and other interested groups.

The district is adjacent to the existing Central Artery and to the proposed construction activity, and could be adversely effected during construction. Design and construction specifications will be reviewed by the Project Conservator.

Russia Wharf (27): Located on Atlantic Avenue and Congress Street, this National Register district consists of a fine trio of intact late 19th century commercial/industrial structures, all Classical Revival in style.

During construction, excavation of the northbound tunnel box would have potential adverse effects on Russia Wharf. These potential effects will be mitigated through design and construction specifications reviewed by the Project Conservator.

The Proposed Action could also have an adverse effect on the district by including visual elements out of scale with the wharf buildings. A ventilation building (3) is proposed for the Boston Edison substation site on Atlantic Avenue (between Congress Street and Northern Avenue), adjacent to Russia Wharf. Although most of the ventilation equipment could be underground, the structure is likely to be 155 feet high and the stacks 240 feet high.

Mitigation measures for this impact are stipulated in the MOA and stated above under Gridley Street District. In addition, a separate stipulation (#2) defined to mitigate the impact of siting ventilation structures in the Fort Point Channel District applies to this location as well. The MOA states that FHWA would "ensure that design development in this (Fort Point Channel) area will include . . . design and location of the ventilation building in a manner that is sympathetic to, and respectful of, the characteristics of surrounding historic properties with regard to massing, color, building material, detail, and scale." These design considerations would serve to mitigate the adverse visual impacts on any historic properties adjacent to proposed ventilation buildings.

South Station Headhouse (28): This National Register structure is significant as Boston's first monumental public example of Neo-Classical Revival style; it represents a landmark point in the evolution of railroad station planning and was a prototype for the double-decker track system.

Due to South Station's proximity to the Atlantic Avenue Proposed Action construction, there could be potential structural and architectural damage if it is left unmitigated. These potential adverse effects will be mitigated through design and construction specifications reviewed by the Project Conservator.

Leather District (26): This National Register district is a homogeneous area of late 19th century commercial buildings related to Boston's important leather trade. It is roughly bounded by Atlantic Avenue on the east, Kneeland Street on the south, and the Surface Artery on the west.

The proposed Atlantic Avenue tunnel would have the positive impact of removing heavy traffic loads from local streets through the district, thus improving the ambience and character of this area.

Proposed Action construction activity on Atlantic Avenue and the relocation of the New Eastside interceptor (NESI) in Lincoln, Tufts, and South Streets could have adverse effects on some historic resources. These potentially adverse effects will be mitigated through design and construction specifications reviewed by the Project Conservator.

Essex/Kingston Textile District (8): This district is centered at the intersection of Essex and Kingston Streets, adjacent to the Chinatown District. The district consists of high-quality late 19th century brick manufacturing and wholesale houses, historically associated with the City's textile trade.

The Proposed Action calls for the closing of the southbound off-ramp to Beach Street and for the narrowing away from Chinatown of the Surface Artery to a one-way southbound facility. These changes will make available a small parcel or parcels adjacent to the Essex/Kingston Streets District for open space or other development.

The Proposed Action will have no adverse effect on the Essex/Kingston Textile District.

Central Area - I-93/I-90 Interchange And Massachusetts Avenue Interchange Area (See Figures 10.3 And 10.4).

Chinatown District (9): The Chinatown District is comprised largely of brick row houses built in the mid-19th century, around an area of Boston known as South Cove. Large-scale filling of the South Cove area in 1833 provided the Boston & Worcester Railroad with a terminal and rail yard. These early row houses were built in response to this development and have housed successive waves of immigrants since that time.

The Proposed Action would have positive long-term effects on the historic district. Two new roadways would be created: the Albany Street Extension and the ramp linking this street with I-90 westbound about 7 feet above the current Kneeland Street/I-90 ramp. Though at a higher elevation, these new roadways would be constructed 25 to 100 feet further away from the historic structures along Hudson Street than the present alignment. The new configuration would improve the visual environment of the Chinatown District, while also reducing current levels of noise and vibration.

The Beach Street ramps would also be closed as part of the Proposed Action. Traffic would be routed onto Marginal Road, a street on the district's periphery. This closure would improve the pedestrian environment because it would create a more attractive and accessible entrance to Chinatown.

In addition, Edinboro Street would connect to Beach Street; Kingston Street would connect with the Surface Artery, not with Edinboro and Hudson Streets; and Hudson Street would be dead-ended at a point approximately 200 feet east of its present connection to Harrison Avenue. These street pattern changes would have no adverse effect on the character of the historic district; rather, they would improve the visual ambience and create a more appropriate edge on Hudson Street than exists today.

The ventilation building (2) proposed for a site within the interchange is approximately 800 feet east of the district's Hudson Street border. The building's two-story massing and stacks (90 feet high) would be consistent in character with the nearby industrial and commercial uses of the Fort Point Channel and Leather Districts, respectively. The historic power plant at 155 Kneeland Street has stacks reaching 160 feet high. The ventilation building will have no adverse effect on the Chinatown District.

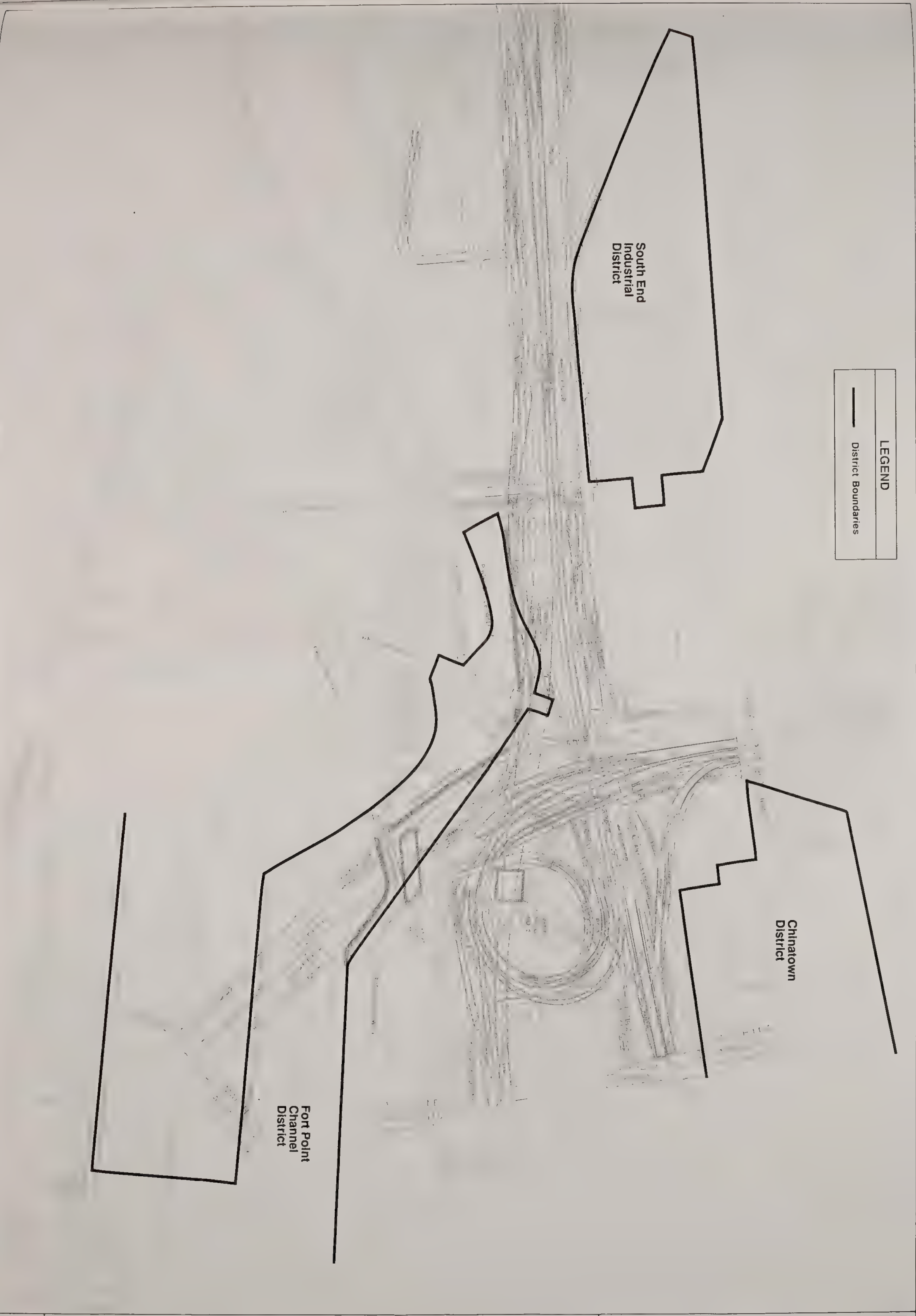


FIGURE 10.4

Historic Resources - Affected Properties I-93/I-90 Interchange And Massachusetts Avenue Interchange Area Alignment

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

Many of the buildings in the Chinatown District are in poor structural condition and set on weak soil. Construction of the Proposed Action and relocation of NESI could have adverse effects on some historic structures in this district. These potentially adverse effects will be mitigated through design and construction specifications designed to protect the structures. These specifications will be reviewed by the Project Conservator.

I-93/I-90 Interchange And Massachusetts Avenue - South Boston Area.
South End Industrial District (33) (See Figure 10.4): Considered eligible for the National Register, this district is an expanded version of the FEIS/R-identified district called "Albany Street Area." The district consists of a largely intact group of late 19th and early 20th century brick industrial buildings with some tenements and workers' housing along the periphery.

The Proposed Action will modify Albany Street north of the district as part of the planned frontage road system and create new ramps connecting to the I-93/I-90 Interchange. Given the visual character of the existing interchange, the project would not introduce new elements out of character with the district, nor would it alter the character of the setting. With the Proposed Action, the frontage roads will be elevated over an intricate network of existing railroad tracks and the proposed I-93/I-90 Interchange, insuring preservation and expansion of the local traffic system. The western curb of Albany Street adjacent to the historic district would not be changed.

The Proposed Action could have adverse effects on some historic structures in this district during construction. These potential effects will be mitigated through design and construction specifications designed to protect the structures. These specifications will be reviewed by the Project Conservator.

Fort Point Channel District (29) (See Figures 10.3, 10.4, And 10.5): The district is located in South Boston and encompasses 98 industrial, commercial, and civic buildings, as well as six bridges spanning Fort Point Channel. Most of the land and buildings within the district were developed by the Boston Wharf Company between 1839 and 1882. The district is considered eligible for listing on the National Register.

With the Proposed Action, the northbound I-93 Atlantic Avenue alignment in this area would be west of the Channel. The proposed Seaport Access Road (I-90) would begin at the terminus of the existing I-90, cross under Fort Point Channel, and travel northeast through South Boston (and the Fort Point Channel District) connecting with the Third Harbor Tunnel at the Subaru Terminal.

The Seaport Access Road construction would remove the Old Colony Railroad Bridge (1896-1899) after HAER documentation as stipulated in the MOA. As previously determined in the FEIS/R, there is no prudent and feasible alternative plan to taking this historic but outmoded resource. In addition, construction of the Seaport Access Road tunnel and graving basin for tunnel section assembly would require the removal and reconstruction of approximately 800 linear feet of the historic Fort Point Channel granite bulkhead (400 feet on either side). A small portion of the Channel (between the Dorchester Avenue bridge and the Old Colony Railroad Bridge) would be filled in order to support the proposed ventilation building (1), located just west of the Dorchester Avenue bridge.

The new structures which would affect the Fort Point Channel District over the long term are ventilation building 3 at the Boston Edison site, ventilation buildings 1 and 2 in the I-93/I-90 Interchange, and ventilation building 5 adjacent to Summer Street in Commonwealth Flats. Only the stacks of building 5 would be considerably taller than other structures in the area. However, because most of the historic resources here are generally large in scale and massing, the new elements would not be significantly out of character with the district when appropriately designed. MOA stipulations which cover these ventilation buildings are listed below.

The construction of the new northbound Frontage Road would require an at-grade intersection with the Broadway bridge, between piers 16 and 17, thereby altering the appearance of the western approach span. Relocation of the Wye railroad connector under the Broadway bridge would also require structural modification of the bridge at this point for vertical clearance, and potentially require replacement of pier 13 for lateral clearance.

Although the FEIS/R design included the demolition of the Broadway bridge for new roadways, the bridge was not considered eligible for listing on the National Register at that time. Since 1983, it has been determined that the bridge is individually eligible because of its engineering attributes. The Department will mitigate the adverse effects to the Broadway bridge by HAER documentation prior to construction.

The House of Bianchi (A Street) will be demolished, as was stated in the FEIS/R. This adverse effect will be mitigated by HABS documentation of the building.

The MOA called for (stipulation #2) the following measures to mitigate the effects to the Fort Point Channel Historic District:

- o Design and location of the ventilation buildings in a manner that is sympathetic to, and respectful of, the characteristics of surrounding historic properties with regard to massing, color, building material, detail, and scale.

- o Use of granite facing in the new sections of the Fort Point Channel bulkhead to make it visually consistent with the existing bulkhead in color, texture, configuration, and design.

- o Reconstruction of the one span of the Summer Street bridge removed during project construction in a manner that reuses as much original fabric as possible and results in the same configuration as the original.

- o Landscaping improvements along the Boston side of the Channel designed to enhance those characteristics of the historic district that make it eligible for listing in the National Register.

- o Continuing study and negotiation with the U.S. Postal Service during preliminary project design concerning the use of land between existing Dorchester Avenue and the Channel bulkhead for project right-of-way. Final design of the new Dorchester Avenue so as to minimize impacts to the historic characteristics of Fort Point Channel and adjacent historic resources, including impacts related to pedestrian and vehicular traffic flow.

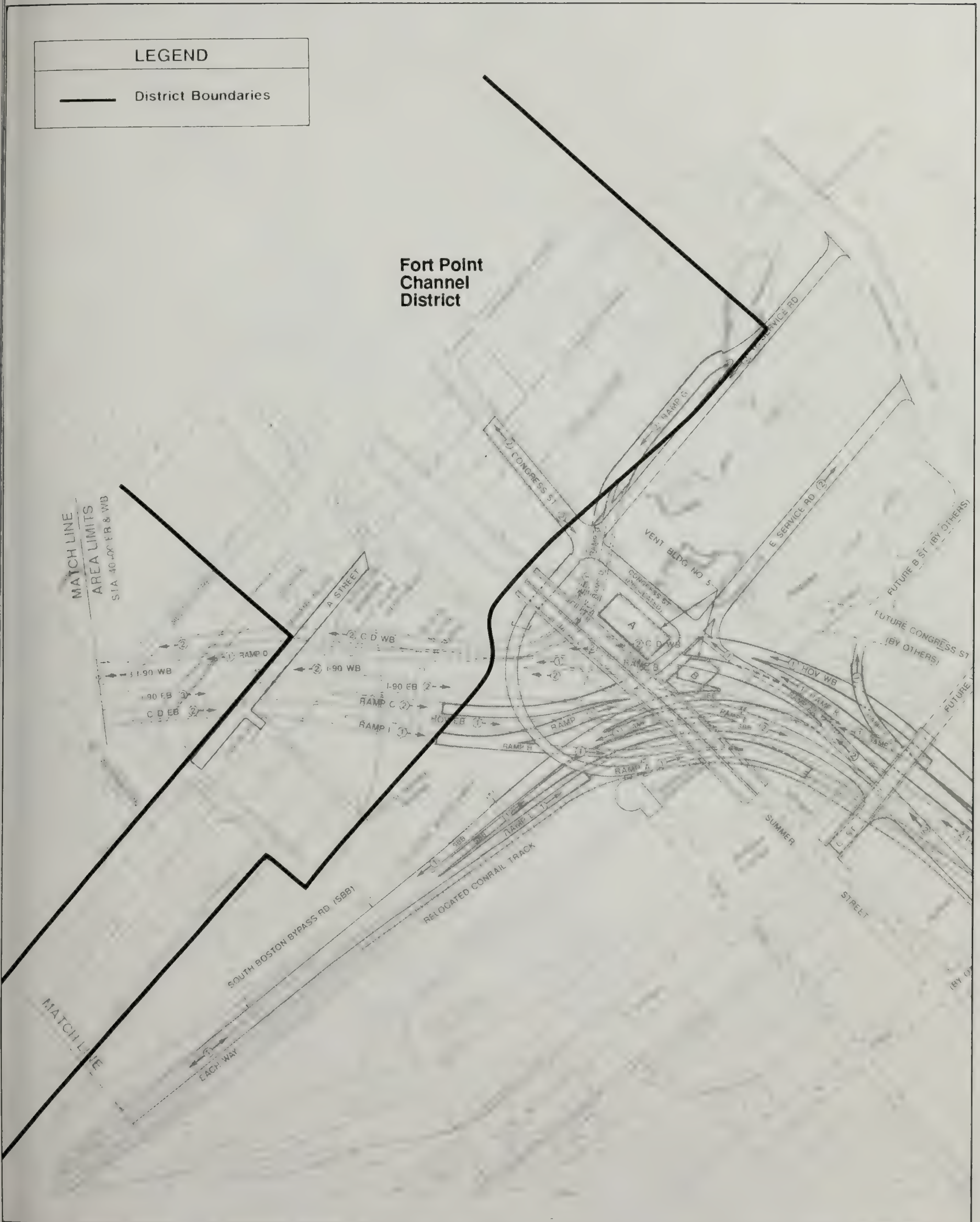
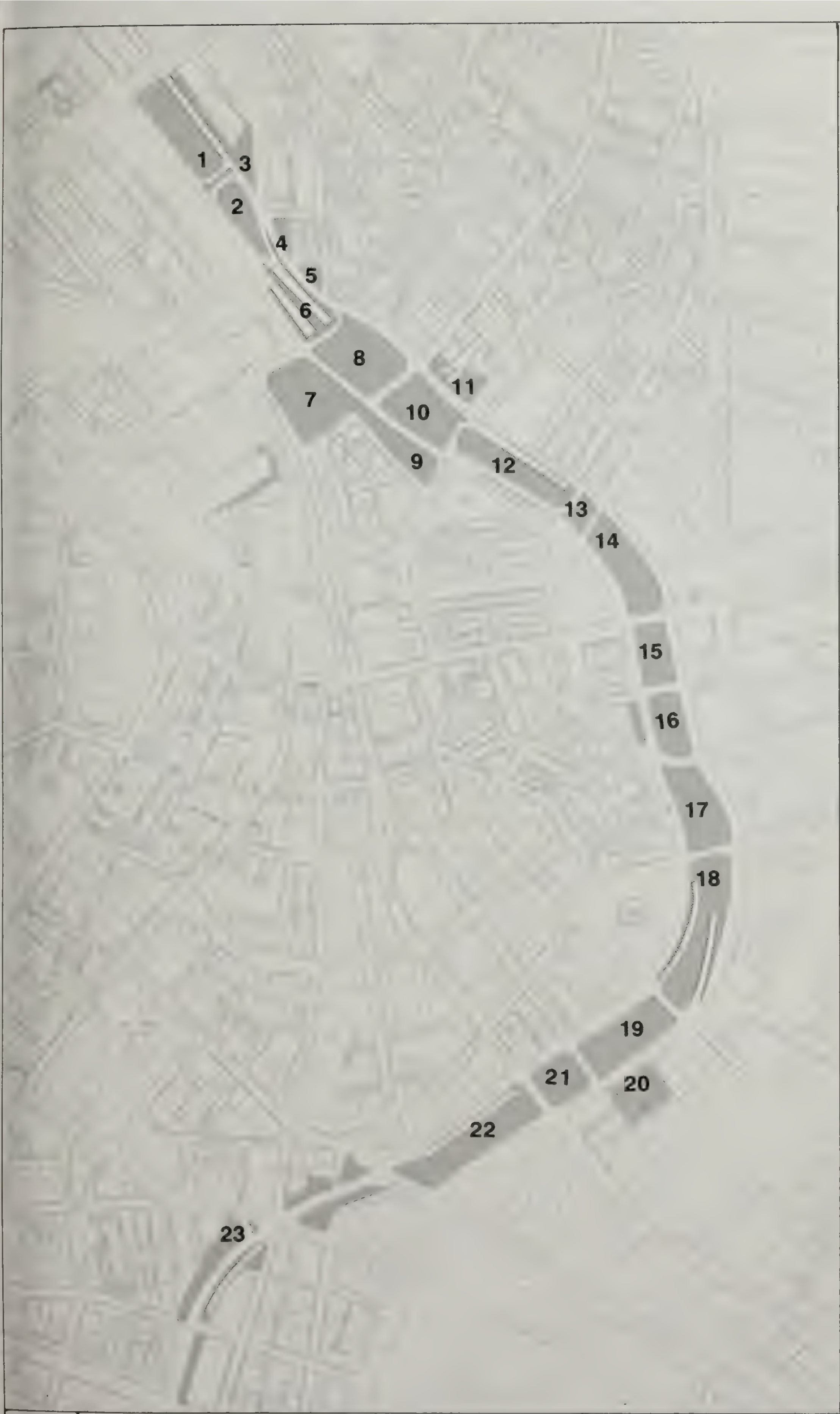


FIGURE 10.5

Historic Resources - Affected Properties South Boston And South Boston Bypass Road Area Alignment

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET



Square Footage Of Parcels

Parcel Designation	Gross Area (Sq. Ft.)
1	84,600
2	26,800
3	15,000
4	5,250
5	5,000
6	52,000
7	85,000
8	76,800
9	33,600
10	60,000
11	22,500
12	82,500
13	12,150
14	64,450
15	30,800
16	37,800
17	64,800
18	107,100
19	69,700
20	31,500
21	38,950
22	113,400
23	32,680
Total	1,152,380

FIGURE

10.6 **New Created Parcels In The Central Area**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

- To mitigate construction period effects to historic buildings, review by the Project Conservator of design plans and construction specifications. Submittal of plans and specifications to the SHPO prior to start of construction, for review and approval in consultation with the BLC regarding consistency with the design development guidelines outlined above.

- HAER documentation of Fort Point Channel, the Summer Street bridge, and the Old Colony Railroad Bridge.

Documentation and reconstruction of the Summer Street bridge is no longer necessary, as the Proposed Action will not affect it. The Proposed Action does not require the use of the Channel or its bulkhead for a new Dorchester Avenue. All other stipulations will be incorporated into Final Section Design packages or, in the case of documentation, carried out by qualified historic resources consultants. The National Park Service has determined the level of HAER documentation required for the Old Colony Railroad Bridge (letter dated July 13, 1989). The Department will request determination of HABS/HAER documentation levels for Fort Point Channel, the Broadway bridge, and the House of Bianchi.

10.3 COMPARISON WITH FEIS/R

The Proposed Action will have a less adverse effect on historic resources than the Preferred Alternative evaluated in the FEIS/R. In summary, the changes in effects are:

- Tower A, which has been scheduled for demolition under the CANA project since 1982, was considered eligible for the National Register by agreement between the MBTA and the SHPO in June 1989. As the Artery/Tunnel Project is refining the CANA loop ramp configuration, the project will mitigate the adverse effect to Tower A by HAER documentation of the structure before demolition.

- The Charles River Basin Historic District's southeast corner will be reconfigured to accommodate a tunnel under Leverett Circle in order to improve traffic flow. This will present no adverse effect to the district.

- 100 Nashua Street is considered eligible for the National Register by 1989 agreement of FHWA and the SHPO. Potential adverse construction effects on this structure will be mitigated through stipulation #4 of the MOA.

- The FEIS/R effects to the Causeway/North Washington Streets District included taking of 100 feet of the Hoffman/Charles River Building, taking of the Stop & Shop Bakery loading dock, and construction of a ventilation building within the district. The Proposed Action has none of these adverse effects. Potential indirect adverse effects from construction remain the same as in the FEIS/R and will be mitigated through stipulations in the MOA.

- A contributing structure to the Bulfinch Triangle District could be adversely affected during construction.

- The Blackstone Block District could be adversely affected by the design and construction of ventilation building 4 on Parcel 7 north of the historic district. The potential adverse effects will be mitigated through design guidelines reviewed by the SHPO and BLC and by mitigation measures reviewed by the Project Conservator.

- The new potential effect to the North End District of obstruction of the vista from City Hall Plaza to Old North Church by development of Parcel 7 will be mitigated through incorporation of the 70-foot-wide preservation easement into design specifications.

- Design modifications locate Ramp CN-SA adjacent to the Fulton/Commercial Streets District. Design and construction specifications designed to mitigate potential effects will be reviewed by the Project Conservator.

- Based on the Project Conservator's evaluation of potential construction period effects to historic structures, the Proposed Action will have no effect on either Faneuil Hall or the Long Wharf District.

- The Oliver/Purchase Streets District is considered to be National Register eligible by agreement of FHWA and the SHPO. One building in this district could experience construction period effects. These adverse effects would be mitigated through the Project Conservator's review of design and construction specifications and monitoring of construction period conditions.

- Russia Wharf would be adversely affected by the construction of the northbound tunnel box in Atlantic Avenue. Design and construction of ventilation building 3 at the adjacent Boston Edison site could also adversely affect Russia Wharf and the nearby newly eligible Gridley Street District. These adverse effects will be mitigated by the Project Conservator's review of design and construction specifications, monitoring of construction period conditions, and SHPO and BLC review of design guidelines for the ventilation structure.

- The Leather District and the South Station Headhouse were not affected by the project in the FEIS/R. Design refinements which place the northbound I-93 tunnel box under Atlantic Avenue could have potential adverse construction period effects to South Station and buildings within the Leather District. Relocation of the NESI within the district also could adversely affect Leather District historic structures during construction. These potential effects will be mitigated by Project Conservator review of design and construction specifications and monitoring of construction period conditions.

- The FEIS/R disclosed extensive potential adverse effects to the Fort Point Channel Historic District. These included removal of 2,200 linear feet of the west Fort Point Channel bulkhead, removal of 400 linear feet of the east bulkhead, demolition of the Old Colony Railroad Bridge, alteration of spans of the Summer Street bridge, filling of the Channel south of the Dorchester Avenue bridge, and demolition of the House of Bianchi. A portion of the highway facilities and ventilation structure were to be located in Upper Fort Point Channel, which was to have been filled south of the Dorchester Avenue bridge.

The Proposed Action eliminates or reduces many of these potential adverse effects. The relocation of the northbound I-93 tunnel box removes all adverse effects to the district north of the Dorchester Avenue bridge, with the exception of potential long-term effects associated with the location of ventilation building 3 at the Boston Edison site. The Fort Point Channel bulkhead will be affected for only approximately 800 linear feet (400 feet on each side) and will be reconstructed consistent with MOA stipulation #2. The Channel south of Dorchester Avenue will be filled only in an area near the new ventilation building 1.

Broadway bridge, which was slated for demolition in the FEIS/R, was not then considered eligible for the National Register. Since then the Department, FHWA, and the SHPO have agreed that the bridge be considered eligible. The Proposed Action will affect the approaches to the bridge. These effects will be mitigated by HAER documentation of the structure.

The FEIS/R contained two ventilation structures located in the Fort Point Channel District and one adjacent. Only portions of ventilation building 1 will be in the district, while ventilation buildings 2, 3, and 5 are adjacent to the district. All will be designed in accordance with guidelines developed with SHPO and BLC review.

The House of Bianchi will be recorded to HABS standards of documentation.

10.4 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

The Massachusetts Historical Commission indicated that the chapter should indicate MHC's involvement in the joint development process, a stipulation in the Memorandum of Agreement in the FEIS/R. The chapter has been amended accordingly.

Chapter 11 – Archaeological Resources

Chapter 11

ARCHAEOLOGICAL RESOURCES

Presented below is the Artery/Tunnel Project inventory of archaeological sites considered eligible for listing on the National Register of Historic Places. (Spectacle Island was the subject of a separate study which is presented in Chapter 20.) A description of the potential effects of the project on these sites and proposed methods to mitigate any potential adverse effects are also included.

As stated in the FEIS/R, the process of identification and evaluation of archaeological resources which might be affected by the Artery/Tunnel Project began in 1982 with a Phase I, Step I archaeological survey report. The 1984 Section 106 Memorandum of Agreement signed by the Federal Highway Administration (FHWA), the Massachusetts Department of Public Works (the Department), the State Historic Preservation Office (SHPO), the Boston Landmarks Commission (BLC), and the Advisory Council on Historic Preservation (Advisory Council) stipulated that a Phase I, Step II/Phase II archaeological investigation of the project's proposed area of environmental impact be conducted in consultation with the Department, SHPO, and BLC. In addition, the archaeological resources have been identified and evaluated in accordance with the requirements of 36 CFR 800.4.

The Phase I, Step II survey was completed and approved by these parties in 1988. It recommended that a Phase II field investigation be conducted to determine the location, extent, integrity, and significance of archaeological resources in specific areas likely to contain such resources. The Phase II field investigation was completed in 1989 and its recommendations were reviewed and approved by the Department, FHWA, SHPO, and BLC in August 1989.

11.1 AFFECTED ENVIRONMENT

The Phase I, Step II archaeological survey included the preparation of a research design, background research of historical and engineering records of past disturbances, historical documentary information concerning potential significance of historic and prehistoric archaeological sites, computer digitized map programs, reviews of past archaeological work, and completion of a Phase I, Step II report titled Phase I Archaeological Report on the Central Artery/Third Harbor Tunnel Project in Boston, Massachusetts (Boston University 1988).

The survey encompassed 89 study blocks and their intervening streets, traffic islands, or bodies of water (Fort Point Channel, the Charles River near its mouth, and Boston Inner Harbor between South Boston and Logan Airport). In at least four places -- the North End, the West End, South Boston, and East Boston -- the study corridor crosses part of the original 17th century Boston landmass (the size of the City has been increased considerably since European settlement by filling of creeks, bays, and the Harbor). Information on the history of land use in each study block was evaluated using the National Register criteria for significance and integrity, and the categories of expected archaeological resources outlined in the project research design as having the potential to meet National Register criteria of significance are as follows:

- Prehistoric Sites: Any reasonably intact prehistoric site could be considered significant on the basis of its ability to offer important information for understanding the prehistory of the region.

- Settlement and Structures: In general, intact archaeological resources relating to settlement and structures that date to the earliest periods of Boston's history [Plantation (1620 to 1675), Colonial (1675 to 1775), and Federal (1775 to 1830)] are likely to be highly significant, as little is known about these periods.

- Wharves and Wharf-related Sites: Intact remains and related information regarding Boston's maritime history are likely to be of significance.

- Landfill: In general, small-scale landfills dating to the 17th and 18th centuries may be considered potentially significant, whereas later landfilling operations of a large scale are not likely to be significant.

- Manufacturing and Industrial Sites: As a general rule, intact archaeological resources of manufacturing and industrial sites are most likely to be of significance for the period from initial settlement through the Early Industrial Period (ca. 1630 to 1870).

- Transportation-related Sites: Archaeological resources relating to the technological aspects of the early period of railroads (ca. 1835 to 1870) are considered to be potentially significant.

Of the 89 study blocks, 75 were determined to contain either no intact archaeological resources as a result of recent construction activities, or archaeological resources that are not considered significant according to established criteria. Most of these study blocks are located in areas of recent fill, and contain 20th century development, in South Bay, South Boston, and East Boston. Portions of six study blocks were identified as potentially containing significant archaeological resources, but these portions are not within the impact corridor of the Proposed Action. Eight study blocks (labeled MP01, NE03, TC01, TC02, TC05, SC02, SB10, and SB12) were recommended for Phase II archaeological field investigation (see Figure 11.1).

As stated above, subsequent to the Phase I, Step II report, the project initiated a Phase II archaeological investigation. Additional historical research, utility research, and field remote sensing as part of this Phase II program established that sites TC05 and SB12 were either inaccessible or destroyed, and they were eliminated from the field testing program. All other study blocks were tested according to a Phase II field, laboratory, and analysis plan permitted by the SHPO's office and the BLC's City Archaeologist. The results of this investigation are contained in the report Phase II Archaeological Investigations of the Central Artery/Third Harbor Tunnel Project in Boston, Massachusetts (2 volumes, Boston University, 1989).

Archaeological testing in study blocks MP01, TC01, and TC02 uncovered remnants of 19th century millpond fill, 19th century additions to Long Wharf, and portions of Central Wharf respectively, but none was considered to be sufficiently intact to warrant a recommendation of eligibility. Archaeological testing at SC02 uncovered only 20th century fill in excess

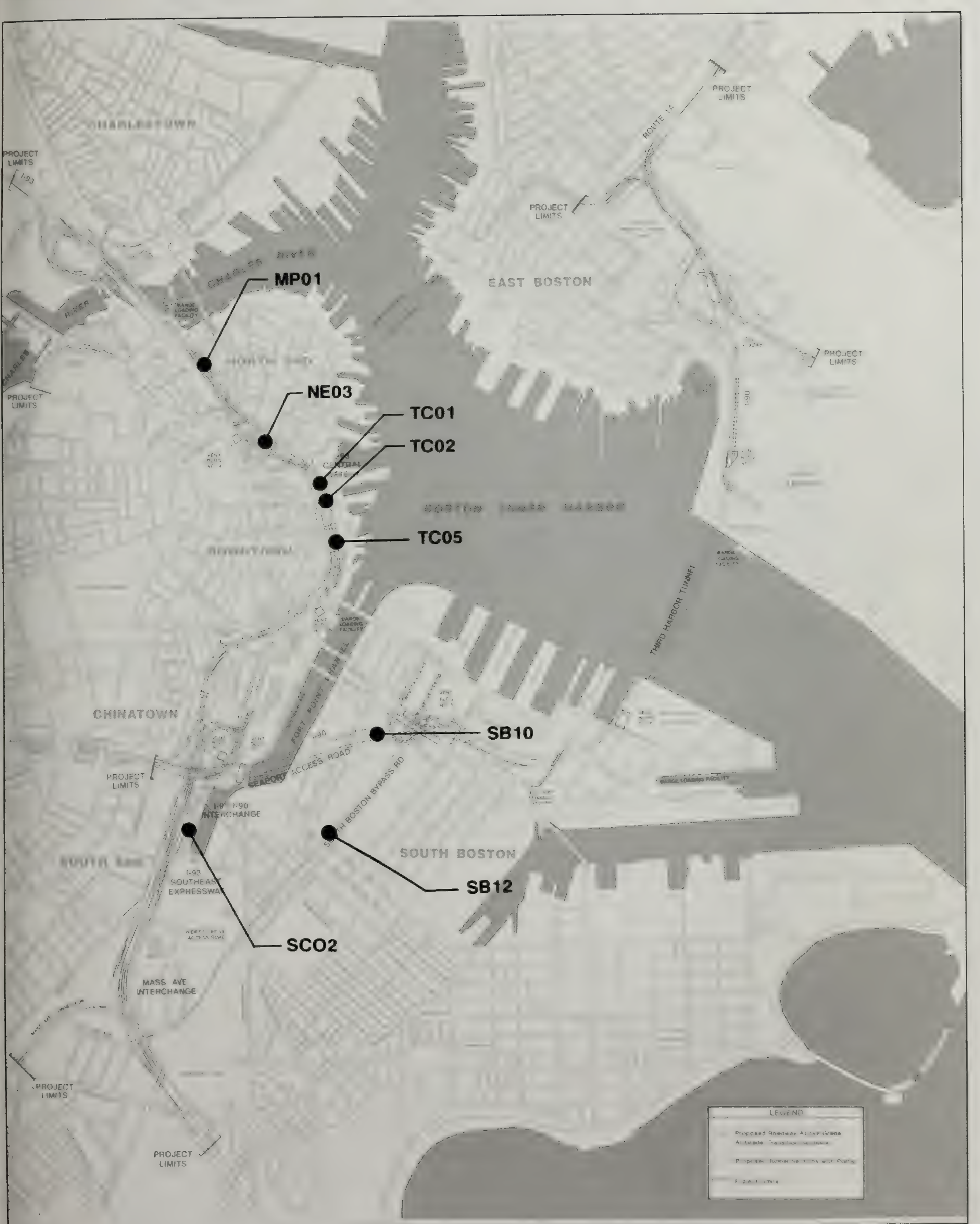


FIGURE
11.1

Archaeological Test Sites

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

of 20 feet and no remains from the early 19th century Cobb Wharf. Excavations at SB10, the presumed location of a 19th century railroad roundhouse, uncovered undifferentiated fill deposits believed to be contaminated by oil and grease.

The Phase II investigation located three significant archaeological sites in study block NE03 near the North End. They are the Mill Pond Wharf site, the Paddy's Alley site, and the Cross Street Backlot site (see Figure 11.2). The Mill Pond Wharf site, located at the north end of NE03, contains the intact remains of a wharf structure, documented through historical research and archaeological context to have been constructed between 1672 and 1709. It is believed that the wharf was no longer in use by 1771. This is an unusual and unexpected find. Historic maps of Boston from this period do not record wharf structures within the Mill Pond, and their existence has not been previously documented. The remains of the wharf structure, the Mill Pond fill (ca. 1821), and several building foundations are considered significant archaeological resources as a unique information source for a little known aspect of Boston's early history -- a private wharf, evidence of waterfront activity, building, and probably commerce along the shore of original land and the Mill Pond. Data recovered from excavation and recording of this feature can assist in developing answers to a variety of questions concerning use and adaptations along the original shoreline of the Shawmut Peninsula: commercial and possibly recreational facilities, privately owned, on a part of Boston's waterfront other than the main Harbor; the form and construction technology of early, small-scale wharves; and the relationship between wharf and original shoreline.

In terms of integrity, the exposed portions of the wharf feature are well preserved, although construction of a granite foundation on the south side has disturbed one portion of the feature.

The Paddy's Alley site is located at the south portion of block NE03 (see Figure 11.2). This site is a house lot which was part of a larger 17th century estate that fronted on North Street and was owned from ca. 1656 through the remainder of the 17th century by the Paddy family. Paddy's Alley later became North Centre Street. Test excavations uncovered intact stratified deposits of various Colonial household occupations dating from the late 17th century to the 1740s and 1750s. Abundant archaeological finds included a wide range of domestic pottery, possibly made in Charlestown, imported ceramic types of English earthenwares and German stonewares, table and window glass, metal, bone, stone, shell, and other objects. Significant archaeological features included a stone wall or foundation, a possible refuse pit, a probable post mold, and an as yet unidentified feature. A preliminary pollen analysis has concluded that soil profiles are sufficiently intact to contribute significantly to an understanding of environmental conditions at this time.

The Paddy's Alley site also uncovered 2,031 fragments of faunal material (bones, etc.). A preliminary analysis of these remains, also contained in the Phase II report, identified major domestic food mammals, some wild fauna such as deer, and four bird species.

This site would provide information on the intensification of residential development during the early 18th century in the North End, as the original large 17th century estate was being split up into (in this case, 17-foot-wide) house lots. The Paddy's Alley house lot is sufficiently intact to provide this information and is considered eligible under National Register criteria.

The Cross Street Backlot site is immediately adjacent to the Paddy's Alley site in NE03 (see Figure 11.2). It is declared a separate site because it has a different site development history. This lot was originally the back part (back lot) of a larger parcel that fronted on the Town Cove and contained a house by 1663. This site is unique because it is believed, based on historical and archaeological evidence, that it was always an "open lot," i.e., no primary buildings (houses, barns, stores, etc.) were built on it. Until the construction of the Central Artery, this small lot was left open to accommodate utilitarian features (such as privies), making it a good candidate for undisturbed archaeological remains.

Archaeological test excavations uncovered a privy or similar feature filled with late 18th/early 19th century artifacts, and an 18th century trash pit. Both deposits are rich in domestic objects. The Cross Street Backlot site is considered significant for its information regarding Colonial and early Federal period settlement, and is eligible for listing under National Register criteria.

Only a few Colonial period archaeological sites have been identified within the original boundaries of Boston (known as Boston Proper). As the Mill Pond Wharf, Paddy's Alley, and Cross Street Backlot sites are from the same period, findings and research conclusions from these sites can be compared with the results of the Central Artery North Area (CANA) Colonial period archaeological sites to broaden understanding of the Boston area's early settlement.

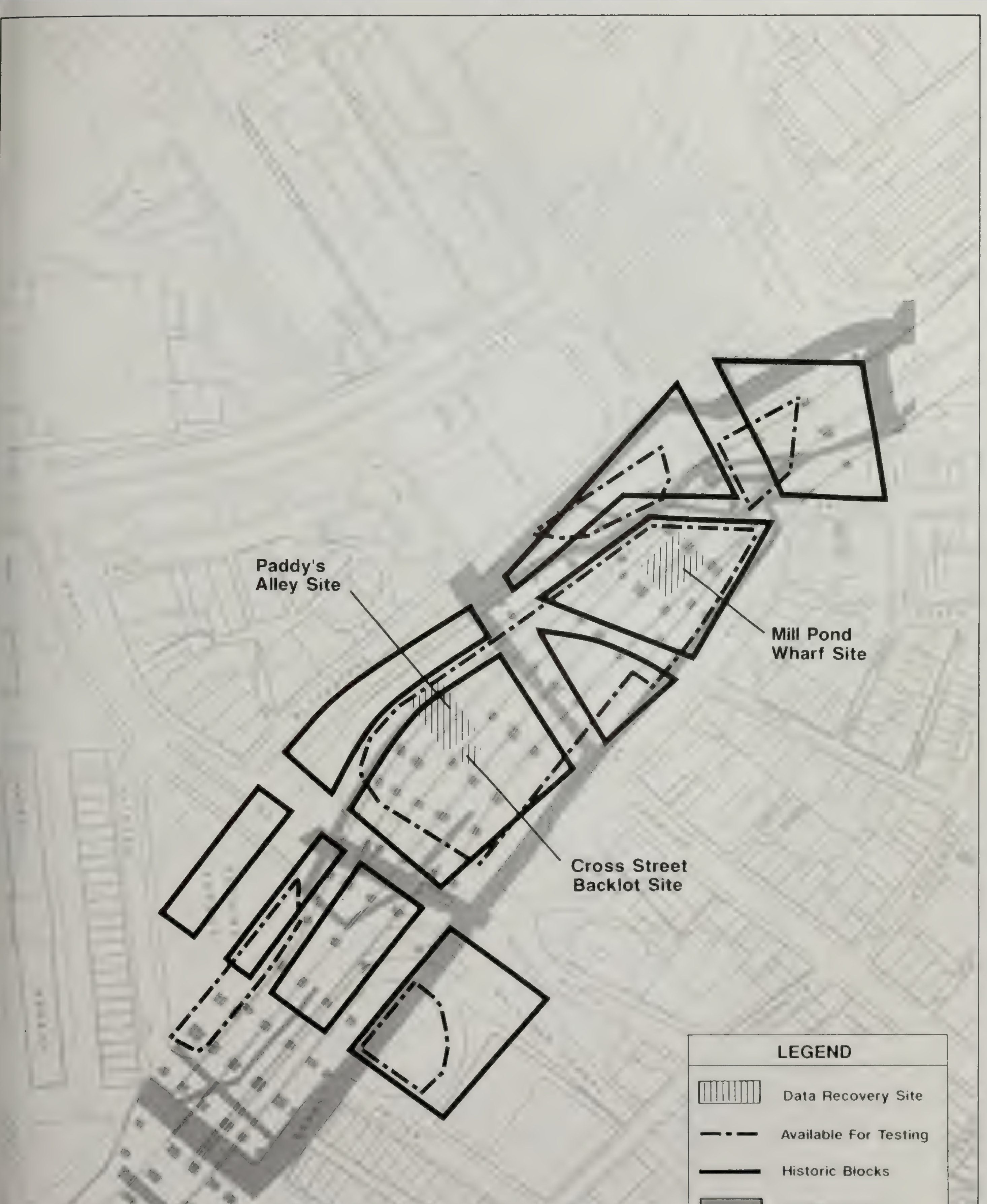
The Mill Pond Wharf site, Paddy's Alley site, and Cross Street Backlot site each meet the criteria for eligibility for listing on the National Register of Historic Places based on the information contained in each site. This information can be retrieved only through excavation.

11.2 ENVIRONMENTAL CONSEQUENCES

The three sites previously described would be adversely affected by the excavation required for construction of the north- and southbound tunnel boxes for the I-93 Central Artery tunnel. However, these potential adverse effects will be mitigated by measures discussed in the following section, as stipulated by the Section 106 Memorandum of Agreement.

11.3 MITIGATION MEASURES

The Artery/Tunnel Project will mitigate these potential adverse effects by undertaking Phase III data recovery activities at all three sites, which will scientifically retrieve the significant information contained in them. The Phase III data recovery program will include research, fieldwork, laboratory analysis, conservation of fragile specimens, report preparation, and public exhibition of results. The program will be reviewed and approved by the SHPO's office before implementation. This work will be completed well before construction of the tunnel boxes in the area of Cross Street and will not affect or delay the project construction.



FIGURE

11.2

North End Archaeological Study Block

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 Feet

11.4 COMPARISON WITH FEIS/R

The FEIS/R contained recommendations for completion of archaeological site identification. The extent of work for the Phase I, Step II/Phase II Archaeological Survey and, therefore, the impacts and mitigation of impacts on archaeological resources, were unresolved issues in the FEIS/R. This chapter has presented the results of the now completed studies, their findings as to impacts, and a mitigation plan.

11.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

There were no major issues raised by public agencies.

Chapter 12 – Utilities

Chapter 12
UTILITIES

This chapter summarizes the utility impacts associated with the Artery/Tunnel Project. Section 12.2 describes the existing utilities located within the right-of-way which will be affected. Section 12.3 describes the utility relocation program being undertaken as part of the Proposed Action, focusing on the utility corridor concept and long-term utility impacts. Sections 12.4 and 12.5 identify mitigation measures and compare utility impacts with those presented in the FEIS/R.

The method of utility relocation chosen will result in a onetime relocation: that is, the relocation of major utilities into permanent utility structures in advance of tunnel excavation. This will provide for minimal disruption to service with tie-overs occurring only once. In addition, the end product will be a new infrastructure for the utility companies, reducing the need for future pavement cuts for maintenance and repair.

12.1 AFFECTED ENVIRONMENT

The Artery/Tunnel Project right-of-way contains a maze of publicly and privately owned utilities. There are seven types of major utilities located within the right-of-way: wastewater facilities, storm drains, water mains, and electric, gas, telephone, and steam lines. These utilities are vital to downtown Boston and, in some cases, serve other parts of the City and the Commonwealth. An inventory of the major utilities located within the project limits is provided by subarea in the Supportive Engineering Report Appendix. These data update the information in the FEIS/R.

There are combined and sanitary sewers, stormwater drains, water mains, electrical ducts, and telephone and gas lines located in each of the five project subareas. In addition, there are steam lines located in the Central Area and the I-93/I-90 Interchange and South Boston areas, and fuel lines in the Area North of Causeway Street, South Boston, and East Boston. There is a cooling water intake-outfall facility in Fort Point Channel serving the Gillette plant near the I-93/I-90 Interchange area, and railroad drains and an electrical substation in East Boston.

Existing utilities in Boston have been constructed over a period of many decades. New lines have been added and existing facilities have been altered, abandoned, and repaired. As a result of this incremental development, existing utility lines often form a tangled web. Individual lines are at different depths and are aligned in different directions, often wrapping around obstacles when they encounter them. Because of these irregular configurations, work on a given utility line can sometimes cause service disruptions in neighboring networks.

12.2 ENVIRONMENTAL CONSEQUENCES

The Artery/Tunnel Project is of such magnitude that it presents a unique opportunity to modernize the maze of existing utility lines within the project alignment. Besides undertaking actions to maintain utility services at all times and restore linkages, the Department will take advantage of this opportunity to build utility corridors (specially constructed underground channels within which various pipes and conduits are placed) as a part of the Proposed Action. These types of improvements will not only limit service disruptions during construction but also help to minimize traffic congestion associated with utility changes, limit service disruptions during roadway repair work, and allow efficient maintenance of utility lines long after the project is completed.

It is estimated that approximately 154,000 linear feet of major lines will be affected. In total, over 29 miles of existing utility lines will be relocated within the 7-mile alignment of the project. Over half of these relocations will occur in the Central Area, between Kneeland and Causeway Streets, where 14.6 miles of lines will be redistributed within 1.5 miles of roadway, which represents only 19 percent of the total Artery/Tunnel Project length. (Table 12.1 indicates the length of proposed utility relocations by project subarea.)

The East Boston subarea will experience the second most intensive relocation program (most work will take place on airport property); it is followed by South Boston (largely on vacant industrial land), and then by the I-93/I-90 Interchange area. The Area North of Causeway Street will have the smallest number of relocations, as the alignment will be largely on elevated viaduct in this project subarea.

The major long-term impact of the Artery/Tunnel Project on utilities will be the efficient placement of the utility lines and the replacement of often antiquated facilities with modern installations. These changes will improve utility service in Boston, adding to the other long-term economic benefits of the project.

Figures 12.1 and 12.2 compare existing utility conditions in a portion of the Central Area with those following construction of the utility corridors. Individual utility lines will be placed parallel to one another, and, as a result, maintenance work on one line will not affect neighboring facilities. In some cases, the lines will not be in local street rights-of-way, thus minimizing traffic congestion normally associated with utility repair and maintenance work.

Certain utilities will be removed from the Artery/Tunnel Project area as a result of the new construction. The Boston Gas Company plans to relocate a 30-inch gas main away from the tunnel excavation in the Central Area to avoid any potentially disruptive situations. In addition, the New England Telephone Company plans to relocate its interoffice telecommunications network to other existing facilities and rights-of-way located throughout the metropolitan Boston area. An advanced fiber optics network facilitating long distance telephone transmissions for a large segment of the eastern Massachusetts market will be developed. The Department and the telephone company have agreed on a plan that will provide for continuous telecommunications service in the Greater Boston area during the construction of the Artery/Tunnel Project. The telephone company's "loop system," which provides local communications services to the downtown area, will be relocated once and only once as a part of the utility corridor program.

Also to be removed from the project area will be the Boston Water and Sewer Commission's New East Side Interceptor. This line is a major 72- to 84-inch sanitary sewage collector

Table 12.1

MILES OF MAJOR UTILITY RELOCATIONS BY SUBAREA

	Miles of Major Relocations	Percent of Total	Percent of Project Length
Central Area	14.6	50	19
East Boston/Logan Airport/ Third Harbor Tunnel Areas	6.2	21	33
South Boston/South Boston Bypass Road Area	4.2	15	14
I-93/I-90 Interchange/and Massachusetts Avenue Interchange Area	2.3	8	23
Area North of Causeway Street	1.8	6	11
TOTALS	29.1[1]	100	100

---

[1] This table does not include many miles of minor utility relocations, service connections to abutters, or the relocation of the New England Telephone Company's interoffice telephone network

Source: Bechtel/Parsons Brinckerhoff

servicing the eastern section of downtown Boston. The existing interceptor runs through portions of the Central Area and I-93/I-90 Interchange area. Due to space limitations and conflicts with the project alignment in the interchange itself, the interceptor will be relocated outside of the alignment. The relocation of these important gas communications, and sanitary sewer networks will be financed through project funds and will not affect the quality of utility service to customers.

12.3 MITIGATION MEASURES

Preliminary utility relocation schemes which are designed to mitigate any construction and long-term impacts have been sent to utility agencies for comments. Once all comments have been received, composite utility relocation plans will be prepared for each subarea and submitted to the Department for approval.

The goal of the relocation program is to minimize service disruptions during construction, and, wherever possible, to rationalize the existing web of utility lines running beneath City streets. One option for maintaining service would be to design a series of temporary relocations for individual utility lines that conflict with project excavation. However, temporary relocations would involve multiple service disruptions, and they are expensive to implement because individual lines would have to be moved more than once.

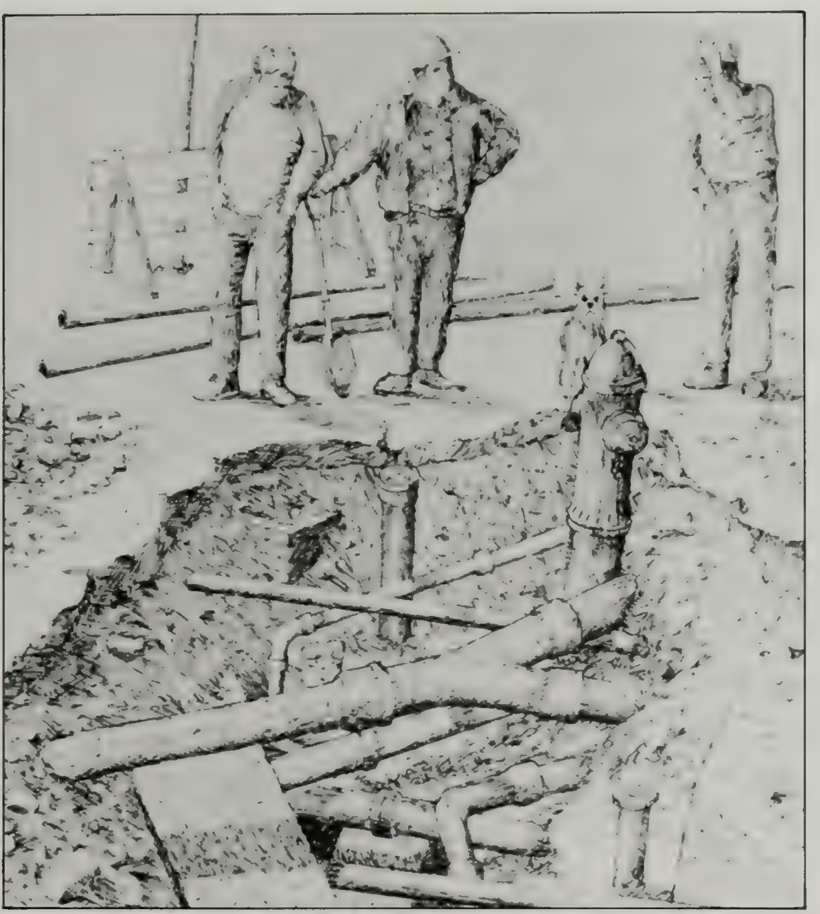
The preferable solution adopted as part of the Proposed Action is to create permanent utility corridors requiring onetime relocation rather than multiple relocations. The different utilities conflicting with project structures will be consolidated in corridors which will be either parallel or perpendicular to the Artery/Tunnel Project right-of-way. Wherever possible, utility corridors will be located outside the tunnel construction area. However, where space is not available, corridors can be constructed directly above the tunnel alignment. In areas with extreme space constraints, it may be necessary to relocate certain utilities to nearby streets and adjacent properties.

12.4 COMPARISON WITH FEIS/R

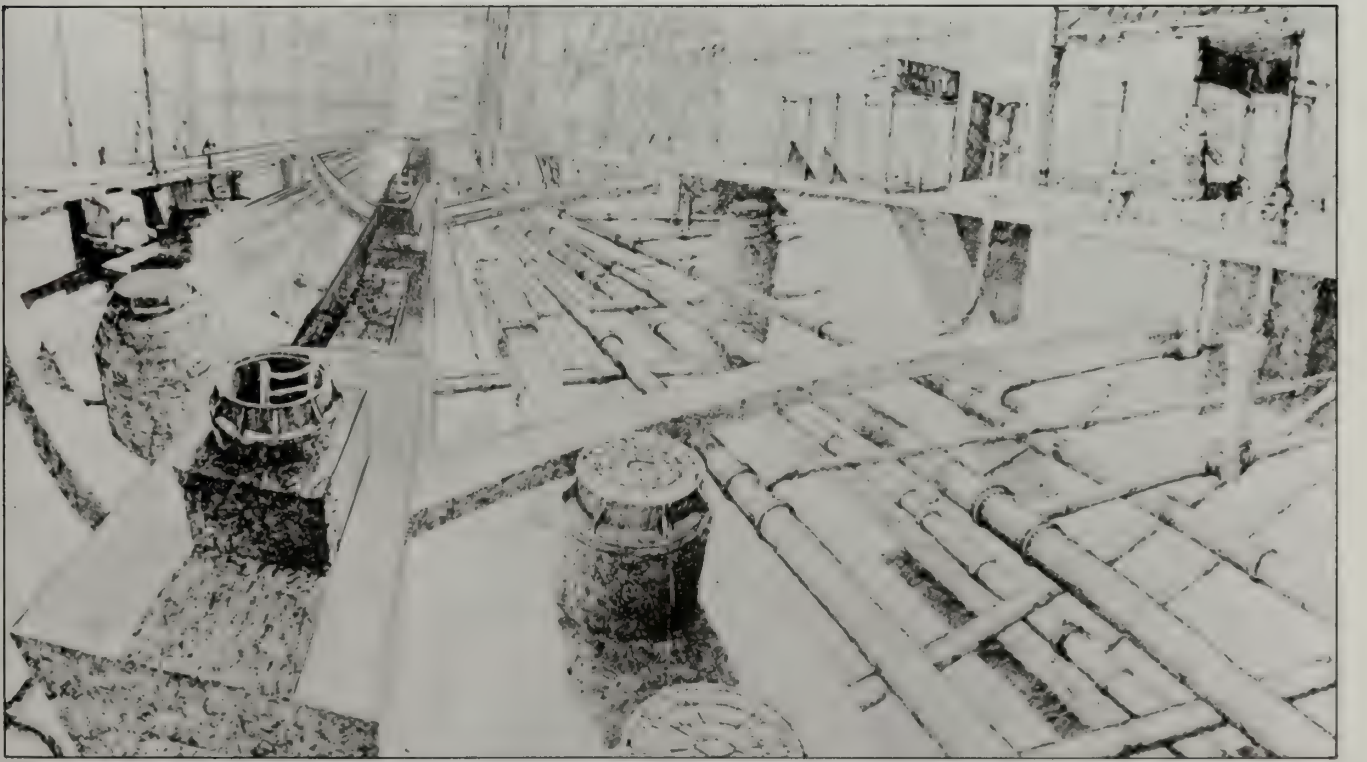
Many of the utility relocation actions included in the Proposed Action are different from those planned for the Preferred Alternative in the FEIS/R. The principal reason for these changes is that a more thorough analysis of existing utilities located in the project area has been undertaken for the SEIS/R. Changes and refinements in the project alignment, as well as the installation of new utilities since 1985, also have added to the scope of work.

The figures and corresponding tables found in Chapters 2, 3, 4, 5, and 7 of the Supportive Engineering Report indicate all of the major utilities that will be affected by the Artery/Tunnel Project. Utility relocations marked with asterisks in the tables in the SER were not included in the FEIS/R. Any utilities that were to be relocated under the previous program, but are no longer affected due to alignment alterations, do not appear in the tables.

The FEIS/R proposed the use of inverted siphons for the relocation of wastewater and stormwater facilities at Milk Street. However, after close coordination with the Boston



Existing conditions



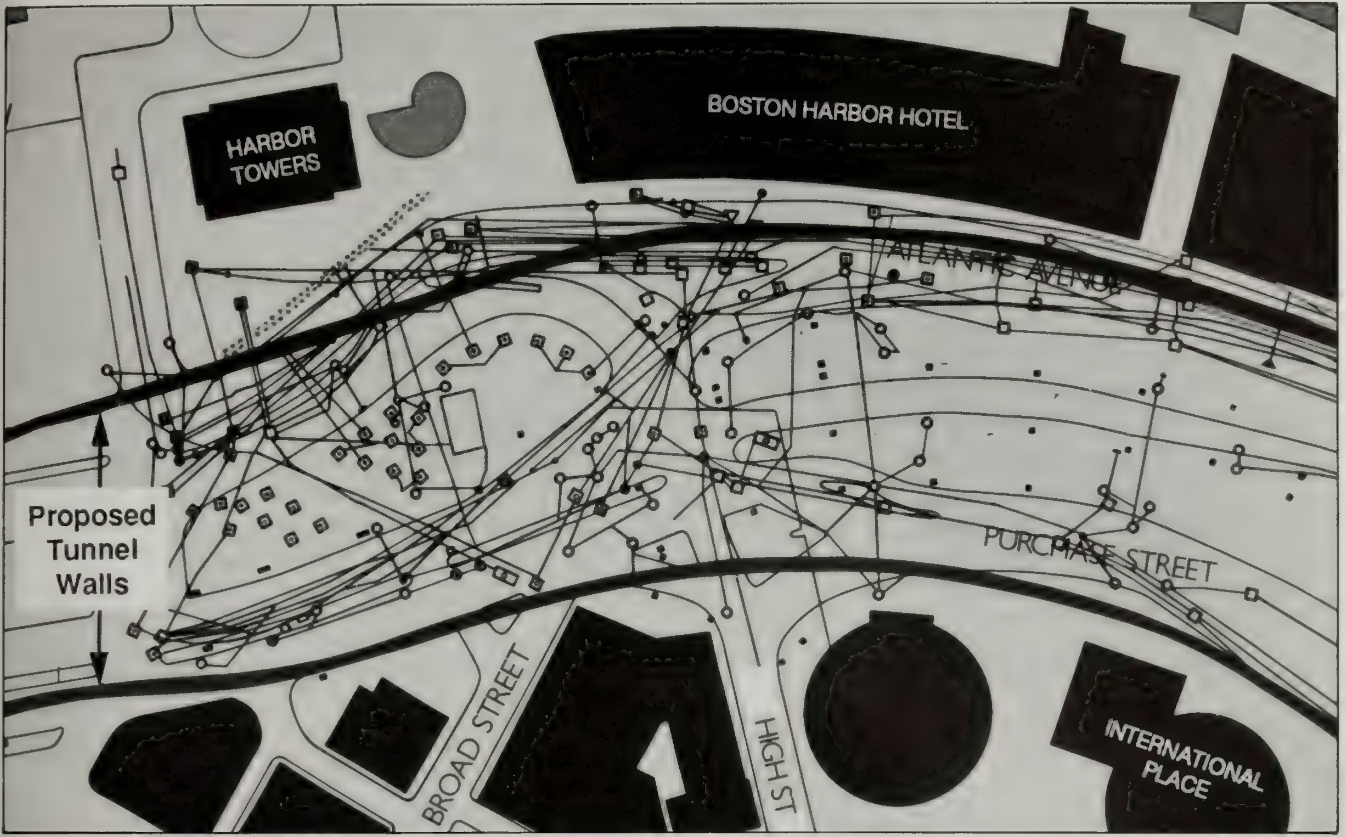
Peel-back view of utility corridor after construction.

FIGURE

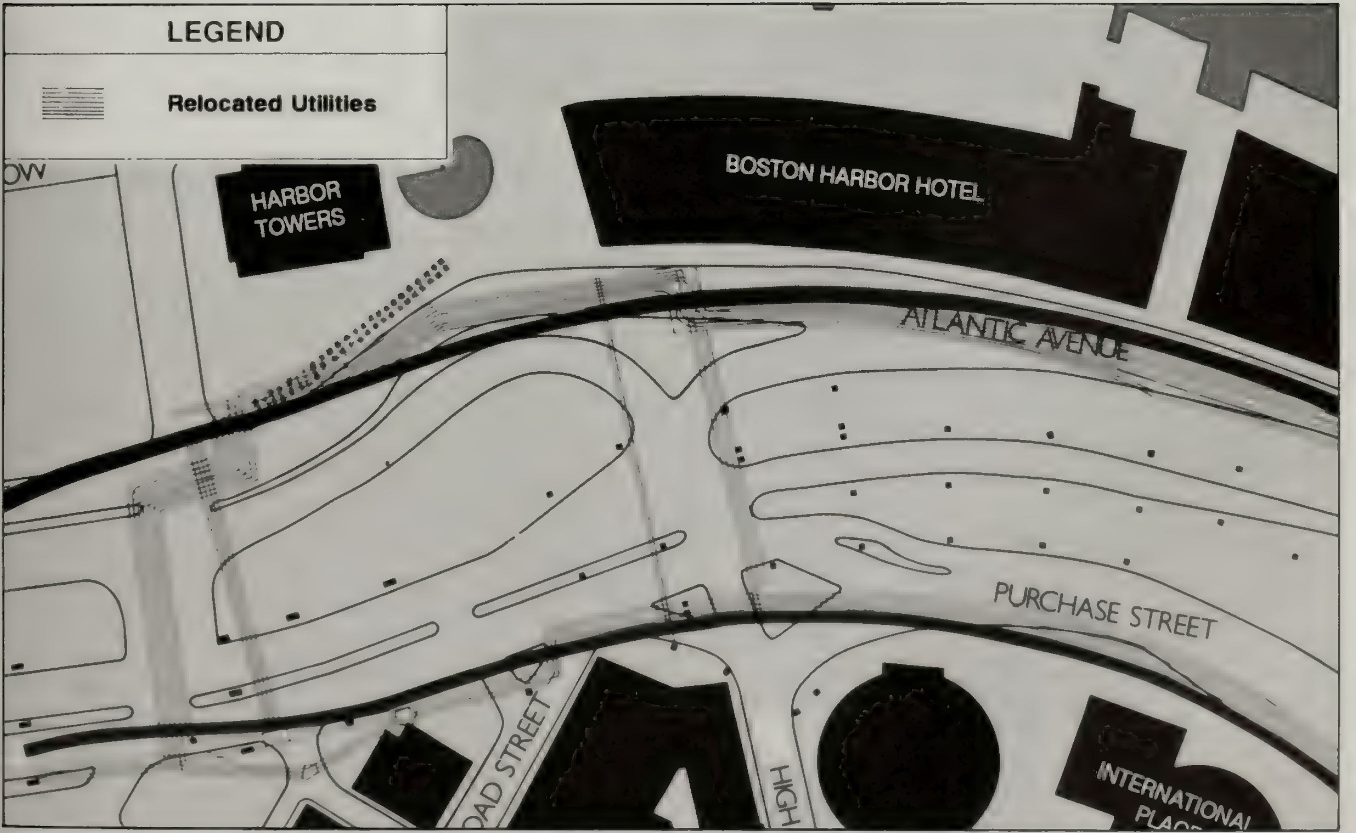
12.1

Before And After
Utility Relocation Program

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



Existing conditions (with tunnel walls in place).



After corridor construction

FIGURE

12.2

Schematic Plan Of Existing And Proposed Utility Network

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Water and Sewer Commission, which had reservations regarding the long-term operational costs of the siphons, all wastewater and stormwater relocations for the project are designed in alternative ways which do not require the addition of such devices.

12.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

The Department has worked closely with affected utility operators throughout the design and refinement of the utility relocation program. Both the Boston Water and Sewer Commission and Massport have raised concerns regarding facilities which could potentially be affected by the project. In many cases, the facilities in question lie outside of Artery/Tunnel Project construction areas. However, in several instances, this kind of coordination has improved project engineers' knowledge of existing conditions and the need for additional relocation work. This kind of close coordination with utility operators will continue throughout the duration of the project.

Several agencies have commented on stormwater runoff. This issue is treated in Chapter 13, Water Quality.

Chapter 13 – Water Quality

Chapter 13
WATER QUALITY

This chapter reviews the existing environmental and groundwater conditions and discusses the long-term water quality impacts of the Proposed Action. A comparison of existing and proposed drainage systems is presented which highlights mitigation measures the Department will implement to reduce the impacts of stormwater discharges from the project. The chapter also compares this discussion with the water quality presentation in the 1985 FEIS/R. This review concludes that the Proposed Action will have no long-term effects on groundwater quality; the total amount of stormwater generated will not change significantly, although drainage patterns will be altered; and implementation of the project will aid in the cleanup of Boston Harbor by providing separate storm sewers in many areas currently served by combined sewers.

The impacts of construction on water quality are discussed in Chapter 20 and in Part II of the SEIS/R regarding the Materials Disposal Program.

13.1 AFFECTED ENVIRONMENT

Surface water bodies that the Artery/Tunnel Project could potentially affect in the long term are Fort Point Channel, Boston Inner Harbor, Lower Charles River, and Millers River (see Figure 13.1). In addition, groundwater is considered to be another water body for which impacts are discussed.

In recognition of the various water quality concerns presented by the project, the first part of this section presents a summary of hydrographics, water quality, sediment quality, and marine life data for each of the affected bodies of water.

During preparation of the FEIS/R, baseline conditions were established for hydrographics, water quality, sediment quality, and marine life. During preparation of the SEIS/R, the baselines for sediment quality in Fort Point Channel, Boston Inner Harbor and Lower Charles River were updated through site sampling and analyses. Data gathered subsequent to the FEIS/R also have been used to characterize sediment quality in the Millers River. Therefore, the baseline conditions have been updated for the SEIS/R. Baseline data for marine life, however, were not updated because there have been no appreciable changes in the area which would affect the impact assessments. Baseline water quality data has been extensively updated by others, however, in conjunction with the program being implemented by the Massachusetts Water Resources Authority (MWRA) to clean up Boston Harbor. These data are discussed and referenced with regard to the evaluation of stormwater impacts on surface water quality in Section 13.1.2(b) below.

13.1.1 Fort Point Channel

13.1.1(a) Hydrographics

Fort Point Channel (see Figure 13.2) is a moderately deep waterway (20 to 26 feet in depth) located between Boston to the northwest and South Boston to the southeast. The South Bay (or Upper Fort Point Channel) has been largely filled, while the Lower Fort Point Channel which flows into Boston Inner Harbor has maintained its original hydrographic characteristics.

The Channel is approximately 5,600 feet long and approximately 560 feet wide at its mouth. The length of tidal excursion (the distance a particle of water will travel on an ebb or flood tide) is approximately 2,100 feet. Mean water depth in the Channel relative to mean sea level (MSL) is approximately 20 feet, with a maximum depth of 26 feet below MSL between the Summer Street and Congress Street bridges. The mean tidal prism (water volume between mean low and mean high tide) is 21.5 million cubic feet, while the spring tidal prism is 24.9 million cubic feet (the spring tide generally occurs every 2 weeks when the moon is new or full). As in other areas of Boston Harbor, the range of the spring tide is approximately 11 feet, while the mean tidal range is 9.5 feet. Computations indicate that on average the Channel is flushed once in every 2.1 full tidal cycles (approximately every 26 hours). During storm events, however, Fort Point Channel receives considerable amounts of stormwater discharge through nine different combined sewer overflows (CSOs), including the Roxbury Canal Conduit, which enters at the head of the Channel. Computations also indicate that the average current velocity of water entering or leaving the Channel at the Northern Avenue bridge is approximately 0.1 foot per second (fps).

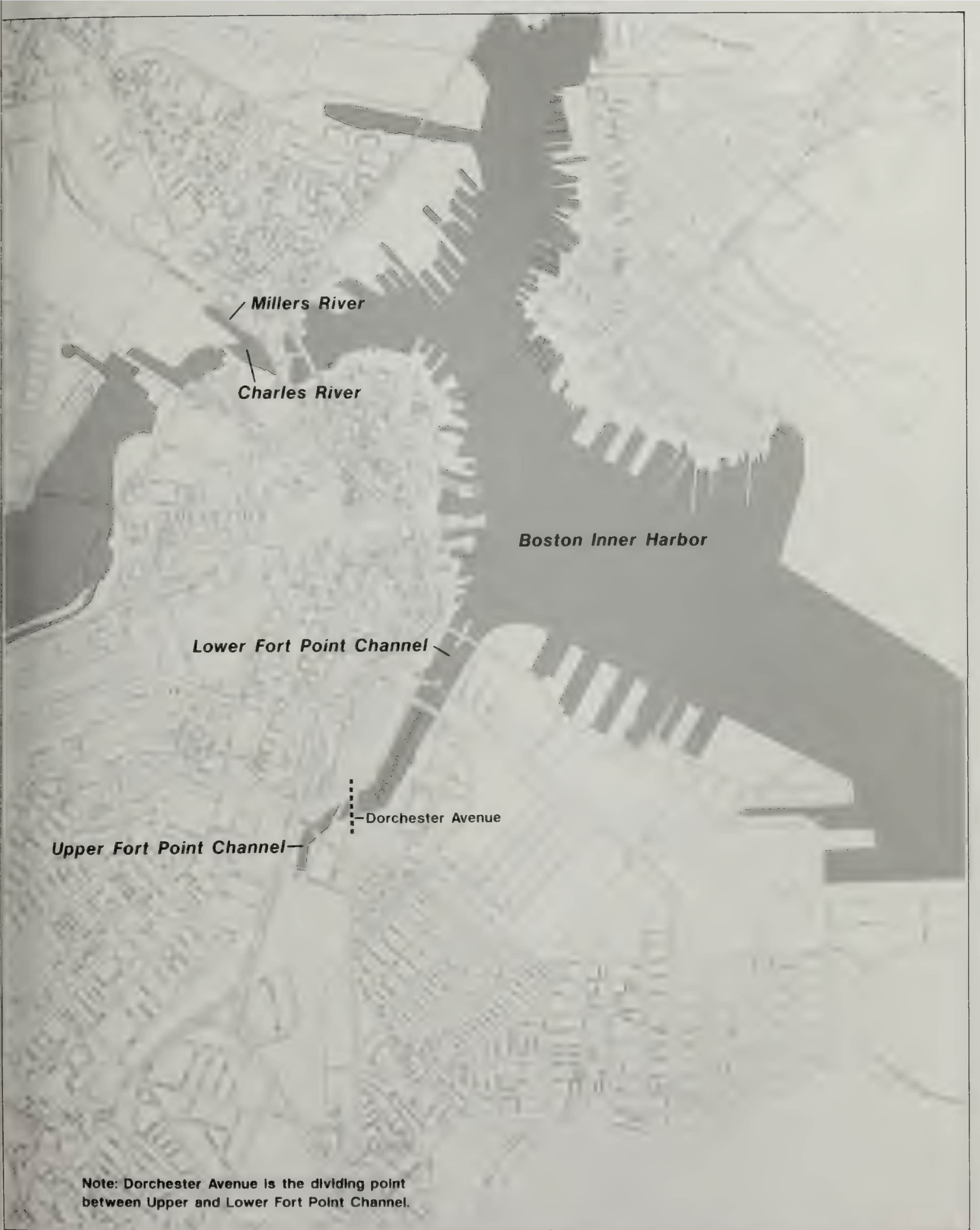
Fort Point Channel enters the Inner Harbor at an angle facing the head of the Harbor. During ebb tides in the Inner Harbor, water tends to be driven into the Channel. Conversely, during flood tides, water from Fort Point Channel can be entrained by currents in the Harbor's main channel, which passes perpendicularly across the mouth of the Channel. This tends to create ebb-like conditions at the mouth of Fort Point Channel during flood tides. The overall affect of the Channel's orientation in relation to the Harbor is, therefore, to reduce current velocities in the Channel and create variable flow patterns at its mouth.

About 3,600 feet from the mouth of the Channel is a once-through industrial cooling water loop for the Gillette manufacturing facility. Hook Lobster and Neptune Seafood Companies also use the Fort Point Channel waters.

13.1.1(b) Water Quality

Water quality conditions in Fort Point Channel are highly variable and depend on the stage of the tidal cycle (ebb or flood) and the occurrence of storm conditions. Nine CSOs are present along and discharge to the Channel. The largest of these is the Roxbury Canal Conduit, which receives sanitary (dry weather) and combined sewer (wet weather) flows from approximately 2,178 acres of residential and commercial development in portions of Dorchester, South Boston, Roxbury, and the South End. There also is a connection between the Dorchester Brook Culvert and the New East Side Interceptor for dry weather flows.

The Massachusetts Department of Environmental Protection (DEP -- formerly known as DEQE) has classified Fort Point Channel as a Class SC water body, indicating that its highest and best uses are the protection and propagation of marine life, and secondary contact recreation. (Water quality criteria associated with the Class SC designation are provided in Table 13.1.) However, DEP has assessed the Channel's attainment of the Class SC standard as "PS" (partial support), meaning that the Class SC standard is not completely met.

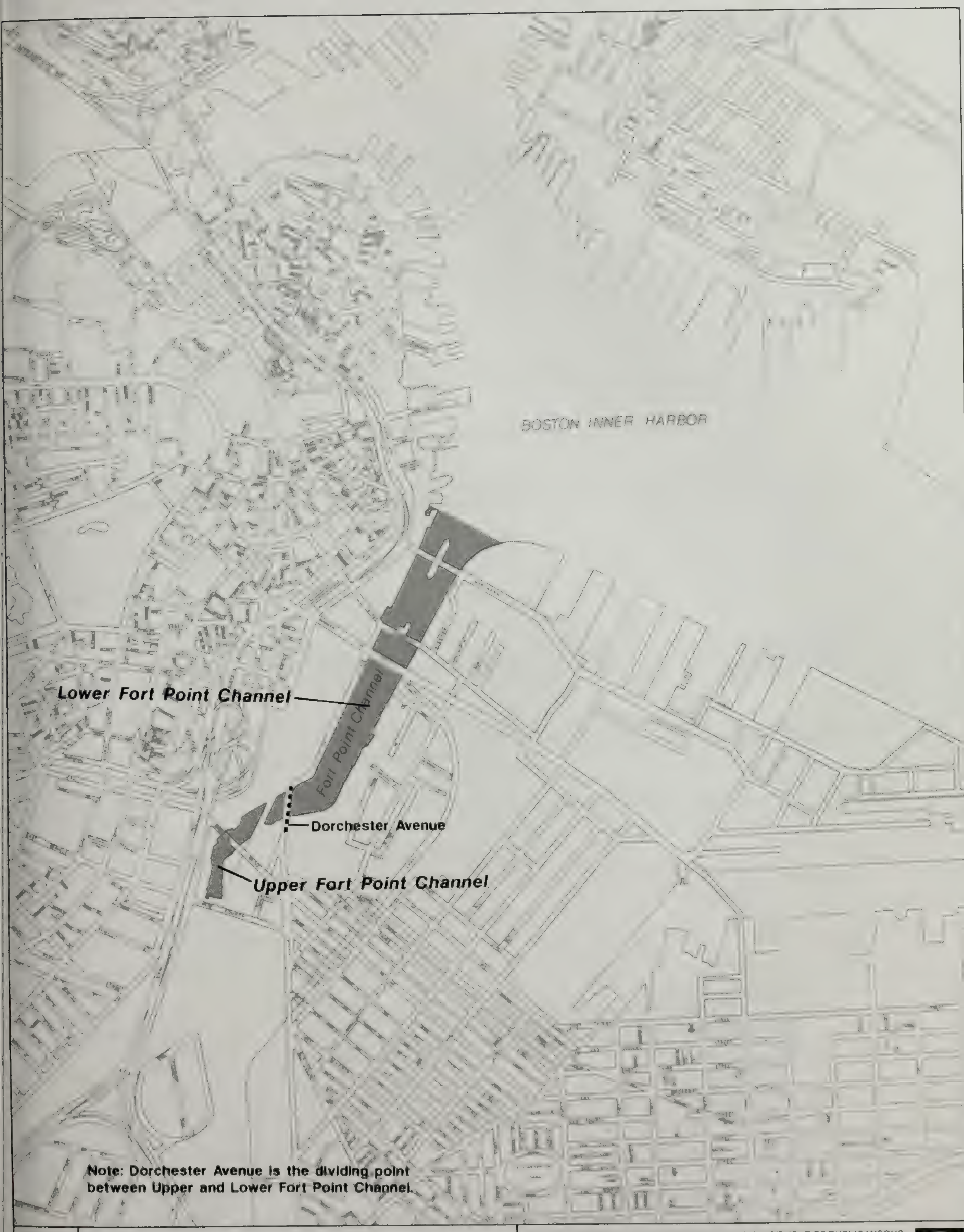


Note: Dorchester Avenue is the dividing point between Upper and Lower Fort Point Channel.

FIGURE 13.1

Project Area Water Bodies

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



Note: Dorchester Avenue is the dividing point between Upper and Lower Fort Point Channel.

FIGURE 13.2

Fort Point Channel Location Map

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 13.1

COMMONWEALTH OF MASSACHUSETTS[1]
WATER QUALITY STANDARDS

Applicable Classes for Inland Waters

Class B: Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life, and wildlife; and for primary and secondary contact recreation.

Class C: Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife; and for secondary contact recreation.

Applicable Class for Coastal and Marine Waters

Class SC: Waters assigned to this class are designated for the protection and propagation of fish, other aquatic fish and wildlife; and for secondary contact recreation.

Parameter	Criteria
Minimum Criteria: The following minimum criteria are adopted and shall be applicable to all surface waters.	
A. These minimum criteria are applicable to all waters of the Commonwealth, unless criteria specified for individual classes are more stringent.	
1. Aesthetics	All waters shall be free from pollutants in concentrations or combinations that: (a) Settle to form objectionable deposits; (b) Float as debris, scum or other matter to form nuisances; (c) Produce objectionable odor, color, taste or turbidity; or (d) Result in the dominance of nuisance species.
2. Radioactive Substances	Shall not exceed the recommended limits of the United States Environmental Protection Agency's National Drinking Water Regulations.
3. Tainting Substances	Shall not be in concentrations or combinations that produce undesirable flavors in the edible portions of aquatic organisms.
4. Color, Turbidity, Total Suspended Solids	Shall not be in concentrations or combinations that would exceed the recommended limits on the most sensitive receiving water use.

Table 13.1 (Cont.)

COMMONWEALTH OF MASSACHUSETTS
WATER QUALITY STANDARDS

Parameter	Criteria
5. Oil and Grease	The water surface shall be free from floating oils, grease and petrochemicals, and any concentrations or combinations in the water column or sediments that are aesthetically objectionable or deleterious to the biota are prohibited. For oil and grease of petroleum origin the maximum allowable discharge concentration is 15 mg/l.
6. Nutrients	Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.
7. Other Constituents	Waters shall be free from pollutants in concentrations or combinations that: (a) Exceed the recommended limits on the most sensitive receiving water use; (b) Injure, are toxic to, or produce adverse physiological or behavioral responses in humans or aquatic life; or (c) Exceed site-specific safe exposure levels determined by bioassay using sensitive species.

B. Inland Waters: the following additional minimum criteria are applicable to inland water classifications.

For Class B waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 5.0 mg/l in warm water fisheries and a minimum of 6.0 mg/l in cold water fisheries.
2. Temperature	Shall not exceed 83°F (28.3°c) in warm water fisheries or 68°F (20°c) in cold water fisheries, nor shall the rise resulting from artificial origin exceed 4.0°F (2.2°c).
3. pH	Shall be in the range of 6.5-8.0 standard units and not more than 0.2 unit outside of the naturally occurring range.
4. Fecal Coliform Bacteria	Shall not exceed a log mean for a set of samples of 200 per 100 ml, nor shall more than 10% of the total samples exceed 400 per 100 ml during any monthly sampling period, except as provided in 314 CMR 4.02(1).

Table 13.1 (Cont.)

COMMONWEALTH OF MASSACHUSETTS WATER QUALITY STANDARDS

Parameter	Criteria
For Class C waters:	
1. Dissolved Oxygen	Shall be a minimum of 5.0 mg/l in warm water fisheries and a minimum of 6.0 mg/l in cold water fisheries.
2. Temperature	Shall not exceed 83°F (28.3°c) in warm water fisheries or 68°F (20°c) in cold water fisheries, nor shall the rise resulting from artificial origin exceed 4.0°F (2.2°c).
3. pH	Shall be in the range of 6.5-9.0 standard units and not more than 0.2 unit outside of the naturally occuring range.
4. Fecal Coliform Bacteria	Shall not exceed a log mean for a set of samples of 1,000 per 100 ml, nor shall more than 10% of the total samples exceed 2,500 per 100 ml during any monthly sampling period, except as provided in 314 CMR 4.02(1).

C. Coastal and Marine Waters: the following additional minimum criteria are applicable to coastal and marine waters.

For Class SC waters:

1. Dissolved Oxygen	Shall be a minimum 85% of saturation at water temperatures above 77°F (25°c) and shall be a minimum of 6.0 mg/l at water temperatures of 77°F (25°c) and below.
2. Temperature Increase	None except where the increase will not exceed the recommended limits on the most sensitive water use.
3. pH	Shall be in the range of 6.5-8.5 standard units and not more than 0.2 units outside the naturally occuring range.
4. Fecal Coliform	Shall not exceed a log mean for a set of samples of 1,000 MPN per 100 ml, nor shall more than 10% of the total samples exceed 2,500 MPN per 100 ml during any monthly sampling period, except as provided in 314 CMR 4.02(1).

---

1. Revised standards have been proposed but have not yet been adopted

Source: 314 CMR 4.00

Table 13.2

EXISTING WATER QUALITY IN FORT POINT CHANNEL
(mg/l unless noted)

Constituent	1982-85 Sampling[1] (Ft. Pt. Channel)	1984 Sampling[2] (Inner Harbor)	1988 Sampling[3] (Ft. Pt. Channel)
Arsenic	0.001 - 0.042	NS	0.05
Cadmium	<0.01 - 0.1	0.00006 - 0.00008	0.0015 - 0.0068
Chromium	<0.02 - 0.06	NS	0.005 - 0.02
Copper	<0.02 - 0.24	0.004 - 0.01	0.004 - 0.01
Lead	<0.04 - 0.39	0.0002 - 0.0006	NS
Mercury	0.0001 - 0.0003	NS	0.0002 - 0.0003
Nickel	<0.03 - 0.24	0.001 - 0.002	0.009 - 0.016
Silver	<0.02 - 0.05	NS	NS
Zinc	0.02 - 0.26	0.005 - 0.009	0.01 - 0.06
TSS	4 - 63	NS	5.0 -49.0
BOD	NS	NS	2.0 - 6.8
NH3-N	0.01 - 0.91	NS	0.8 - 1.1
Fecal coliform[4]	20 - 15,000	NS	50 - 26500
Total coliform[4]	80 - 98,000	NS	1200 -360000
Fecal strep[4]	NS	NS	10 - 2800
Oil and grease	NS	NS	5 - 22

---

1. DEQE, 1982-85
2. Wallace, 1984
3. MWRA, 1989
4. Units in no./100ml
5. NS: Not sampled

Source: Bechtel/Parsons Brinckerhoff

According to the DEP, the Channel's existing water quality problems are metals, fecal coliform, aesthetics, oil and grease, and dissolved oxygen. The sources of the problems are tributary pollutants, CSOs, and sediments.

Dry water sampling throughout Boston Harbor was performed by DEP during the summers of 1982 to 1985 (DEQE, 1982-85). Samples were collected at the mouth of Fort Point Channel. The results of the sampling program are presented in Table 13.2.

The results show that even in dry weather, Class SC water quality standards are not met. Fort Point Channel does not consistently meet standards for metals, fecal coliform, or ammonia nitrogen. Metals concentration even exceed EPA's Gold Book criteria. Fecal coliform standards greatly exceed the standard of 1,000 MPN/100ml, while ammonia nitrogen concentrations exceed the proposed summer standard of 0.5 mg/l.

DEP has recently questioned the validity of these data based on concerns regarding possible inconsistencies in the sampling and analysis methodology. Sampling data from two more recent studies suggest that the water quality of the Inner Harbor may be better than that reported by DEP. The results of these sampling studies are also included on Table 13.2.

In one study (Wallace, *et al.*, 1984), metals data were collected from the Inner Harbor over 4 days in the summer of 1984. The data indicated that copper was the only metal found in concentrations that do not meet the water quality criteria. However, the study covered a small time frame and did not include any sampling points in Fort Point Channel. The water quality in Fort Point Channel is expected to be worse than that in the Inner Harbor because the Roxbury Conduit, one of the two largest CSOs in the Boston area, discharges into the head of the Channel.

In the other study, performed as part of the Draft Boston CSO Facilities Plan (MWRA, 1989), wet and dry weather sampling data were collected throughout the Harbor from the spring through the fall of 1988. Samples taken from Fort Point Channel indicate that some constituents were in concentrations that meet the water quality criteria and standards. Four metals, including arsenic, copper, mercury, and nickel, were found in concentrations that do not meet the criteria. In addition, the concentrations of fecal coliform during both dry and wet weather were found to exceed the State standard.

The Roxbury Conduit CSO is a major contributor of pollutants to Fort Point Channel. The conduit receives dry and wet weather flows from approximately 2,178 acres of residential and commercial development in portions of Dorchester, Roxbury, and the South End. Flows from the Roxbury Conduit were calculated at one point, for a 50-year storm event, to total approximately 3,000 cubic feet per second (cfs). By comparison, the average tidal exchange is about 1,000 cfs. The CSO flux into the Channel is approximately three times greater than the tidal flux. Dry weather flows from the conduit have also been observed discharging into Fort Point Channel.

13.1.1(c) Sediment Quality

Sediment quality in Fort Point Channel has been examined through the collection of core samples followed by bulk chemical analyses. During preparation of the FEIS/R in 1982, core samples were collected and analyzed from four locations along the then-proposed project alignment. Of those samples, two (FP1 and FP2) are applicable to the present alignment.

Data from these cores have been combined with data from two other cores (E-11 and E-61) which were obtained during 1988. (Core sample locations are shown in Figure 13.3. The average bulk sediment concentrations of chemicals at three depths are contained in Table 13.3.)

Data contained in Table 13.3 indicate that the sediments are highly contaminated. However, the contamination is reduced with depth of sediments.

Based on DEP's dredge classification system, the surface sediments fall into Category III because of high concentrations of metals that are well into the Category III level or high contamination category. In addition, there are four nonmetal contaminants present: total petroleum hydrocarbons, polyaromatic hydrocarbons (PAH), PCBs, sodium, and chloride. Lower concentrations are found in deeper sediments where at a depth of 18 feet, four out of eight parameters are within Category II (slightly contaminated).

Extraction procedure toxicity testing (an EPA procedure) was conducted to determine if the sediments would be considered hazardous waste. The results of these tests indicate that the sediments tested one to two orders of magnitude (10 to 100 times) below the EPA thresholds for regulation of the sediments as a hazardous waste.

13.1.1(d) Marine Life

The benthic species listed in Table 13.4 have been reported within the Fort Point Channel project area. For the FEIS/R, four sediment samples along the west side of Fort Point Channel were collected in 1982 and analyzed for benthic macroinvertebrates. Those data indicate that the diversity of marine life living in the bottom sediments is low, with a high preponderance (greater than 99 percent of the sample) of pollution-tolerant worms *(Capitellidae)*.

Examinations of the travelling screen at the Gillette cooling water intake indicate that fish in Fort Point Channel include flounder, stickleback, and mummichog. Other finfish likely to occur in the Channel include smelt, alewife, eel, striped bass, and other species that may enter from the Harbor.

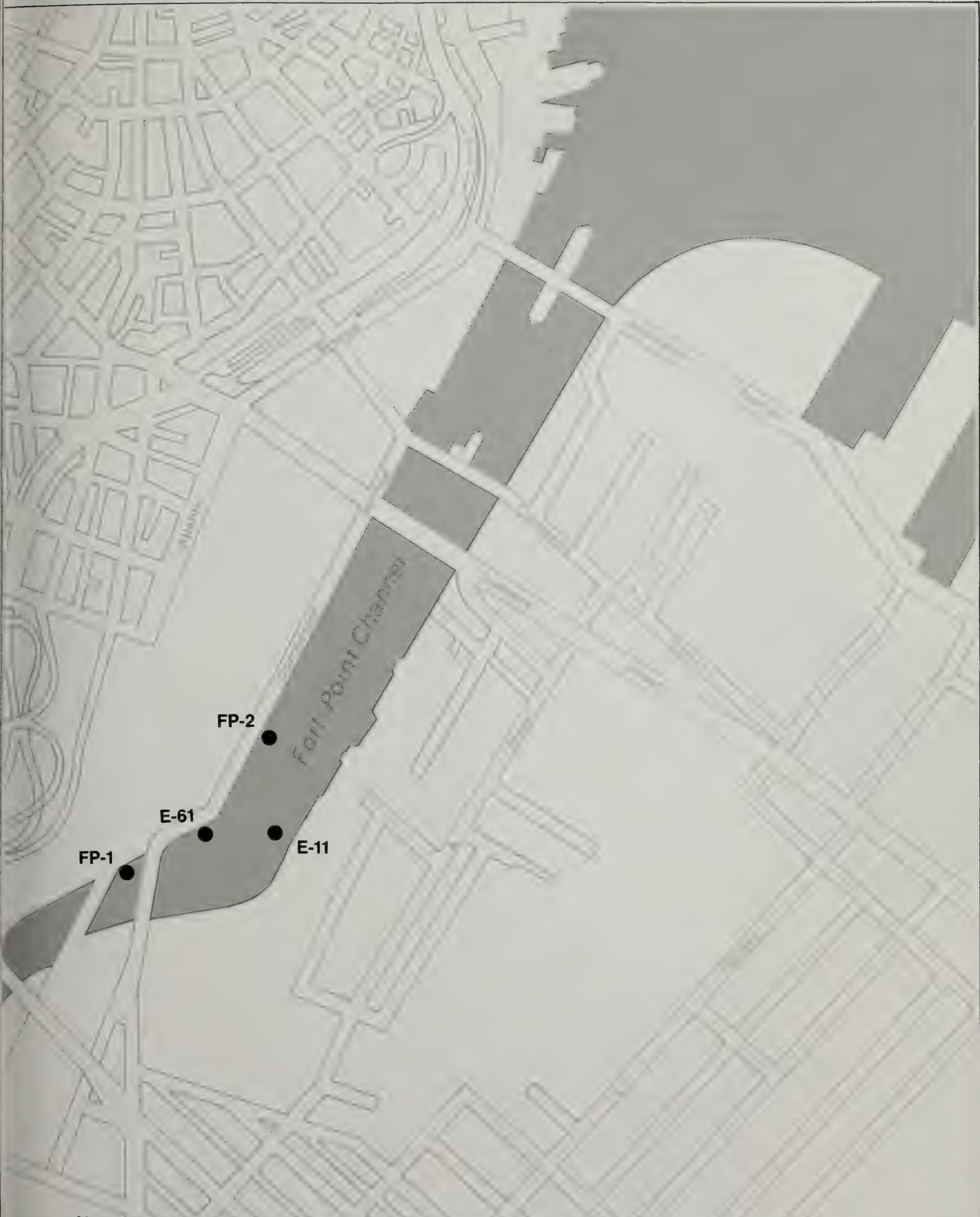
While low densities of shellfish have been found in Fort Point Channel near the Northern Avenue bridge, they are not common in this location, and there are no State-mapped shellfish beds in the area.

13.1.2 Boston Inner Harbor

The Inner Harbor is shown in Figure 13.4.

13.1.2(a) Hydrographics

Boston Harbor experiences semi-diurnal tides (two tidal cycles per day) with a maximum difference between successive high or low tides of 1.6 feet. The mean tidal range of the Harbor is 9.5 feet, which increases to 11.0 feet during spring tide conditions. Maximum spring tides can produce elevations of 2.3 feet below mean low water (MLW) and 2.6 feet above mean high water (MHW) (Levin and Fitzgerald, 1981). High tide levels can increase substantially as a result of regional storm surges.



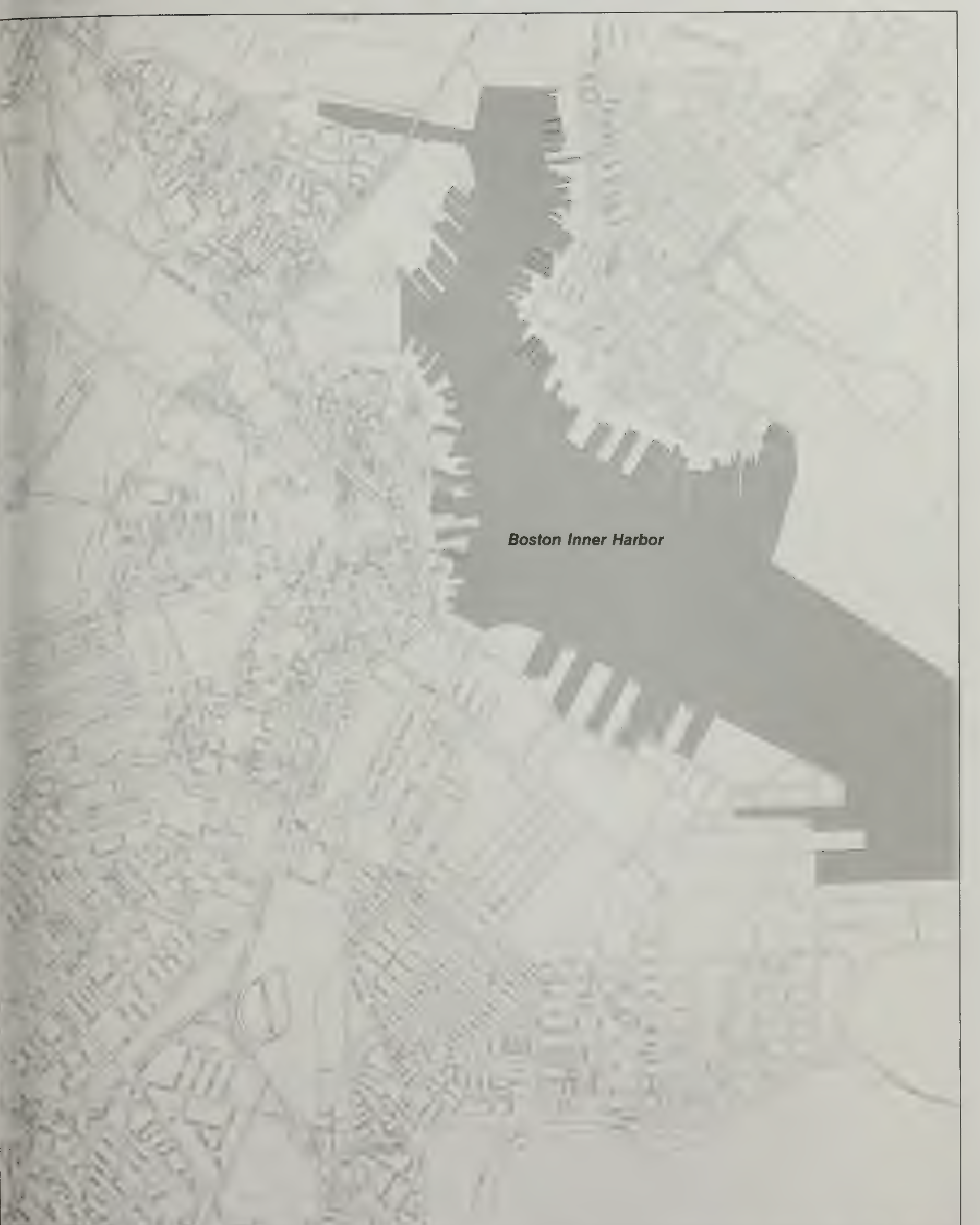
Note: Refer to Table 13.3 for designations.

FIGURE
13.3

Fort Point Channel Core Sample Locations

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 400 800 1200 Feet



FIGURE

13.4

Inner Harbor Location Map

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 13.3

FORT POINT CHANNEL SEDIMENT ANALYSIS

	Depth Of Sample					
	0 to 1 Foot		2 to 4 Feet		6 to 18 Feet	
Parameter (mg/kg)	**Average**	**Maximum**	**Average**	**Maximum**	**Average**	**Maximum**
Arsenic	75.6	181.3	78.7	142.5	14.2	20.0
Cadmium	18.2	34.0	6.0	18.0	1.6	2.78
Chromium	163.9	346.8	64.0	112.0	29.9	37.5
Copper	521.7	1,130.0	253.3	485.0	114.9	322.9
Lead	894.9	1,532.8	451.9	924.9	263.5	647.0
Mercury	6.3	21.8	4.3	16.7	0.5	1.3
Nickel	335.3	763.1	39.5	80.8	21.7	28.6
Zinc	2,625.2	10,100.0	595.1	966.0	156.6	382.0
Vanadium	245.2	758.2	36.1	78.1	---	
PCB	<0.005	<0.005	---		---	
Total Petroleum Hydrocarbons	33,150.0	84,200.0	5,766.7	12,300.0	1,066.7	3,200.0
Sodium	53,300.0	94,800.0	7,105.0	7,700.0	14,800.0	23,600.0
Chloride (%)	4.68	8.5	0.81	0.89	0.48	0.7

---

1. Results in "average" columns are averages of FP-1, FP-2, E-11, and E-61

Sources: Draft Environmental Impact Statement/Report, Third Harbor Tunnel Project, Interstate 90, Boston, Massachusetts, Appendix 7 - Water Resources, Dredge Material Disposal, Vegetation, Wildlife, and Wetlands, U.S. Department of Transportation Federal Highway Administration, FHWA-MA-EIS-82-02-D, December 1982

Massachusetts Department of Public Works, May 1989, Soil Quality Report, prepared by: Jason M. Cortell And Associates, Inc.

Table 13.4

BENTHIC ORGANISMS IN PROJECT RIGHT-OF-WAY IN FORT POINT CHANNEL

ANNELIDA (Segmented Worms)
- *Polychaeta*
  - *Capitella capitata*
  - *Polydora ciliata*
  - *Asabellides oculata*

ARTHROPODA (Shrimp, Scuds, Crabs)
- *Amphipoda*
- *Gammaridea*

MOLLUSCA (Clams, Snails)
- *Bivalvia*
- *Tellina agilis*

Source: Federal Highway Administration, December 1982, Draft Environmental Impact Statement/Report, Third Harbor Tunnel Project, Interstate 90, Boston, Massachusetts, Appendix 7 - Water Resources, Dredged Material Disposal, Vegetation, Wildlife, and Wetlands, FHWA-MA-EIS-82-02-D

Measurements of current speed and direction were conducted at four locations on spring (high) and neap (low) tidal cycles during March 1982 for the FEIS/R. Data from two current meter stations which are very close to the proposed tunnel alignment indicate peak velocities of 1.0 fps during spring tides. The predominant velocities ranged from 0.10 to 0.26 fps.

The small fetch within the Inner Harbor limits the size of wind-generated waves; hence, tidal currents dominate. Because of successive filling during Boston's development, the hydrographic characteristics of the Harbor have changed significantly and now the currents within the Inner Harbor are oriented primarily along the axis of the Harbor.

Calculations of tidal excursion indicate that water within the project area moves approximately 5,600 feet on the ebb tide and approximately 7,000 feet on the flood tide (see Figure 13.5). The flood tide excursion carries water from the proposed Third Harbor Tunnel alignment north to the vicinity of the Callahan/Sumner Tunnels. The ebb excursion extends past the mouth of the Reserved Channel further east in South Boston. The tidal prism for the Inner Harbor is 518 million cubic feet during the mean tide.

Using the tidal prism method, calculations of tidal flushing for the Inner Harbor indicate an average flushing rate of once every 52 hours. This is corroborated by data from Ketchum (1952), which indicate a 50-hour rate based on average annual freshwater inputs.

13.1.2(b) Water Quality

The DEP, Division of Water Pollution Control (DEP/DWPC), has classified Boston Inner Harbor as a Class SC water body. Class SC waters are to be suitable for the protection and propagation of marine life, and secondary contact recreation. (Specific water quality standards applicable to SC waters are shown in Table 13.1.)

Existing water quality information on the Harbor indicates that Class SC standards are not consistently met. Existing water quality data collected by MWRA and summarized in Table 13.5 indicate violations of water quality standards. In addition, the DEP has assessed the Harbor's attainment of the Class SC standard as PS (partial support), meaning that the Class SC standard is not completely met. According to the DEP, the Harbor's water quality problems and the sources are the same as for Fort Point Channel; however, additional Inner Harbor pollutants are generated from separate storm drains, boat discharges, and the Deer Island wastewater treatment plant.

Water quality in the Harbor is impaired by a combination of inadequately treated wastewater that is discharged into the Outer Harbor and many CSOs discharging to the Inner Harbor and its tributaries. During wet weather, the CSOs discharge both stormwater and untreated sewage to the Harbor. Water quality of the Inner Harbor, particularly for such parameters as bacteria, suspended solids, nutrients, and metals, is significantly affected during storms due to the discharges of combined sewer overflows. Much of the stormwater drainage from the present roadway system is currently discharged to CSOs. Removal of stormwater from the combined sewers by providing separate storm sewers has the effect of decreasing the amount of untreated sewage which overflows into the Harbor. To the extent the stormwater is of better quality than the untreated sewage component of the CSO discharge, water quality would improve as a result of separating storm flows from the CSOs. During dry weather these outfalls generally do not contain any wastewater.

Table 13.5

EXISTING WATER QUALITY IN BOSTON INNER HARBOR
(mg/l unless noted)

Constituent	1988 Sampling[1]		
Copper	0.0009	-	0.0116
Zinc	0.0128	-	0.9550
TSS	8	-	188
BOD	2	-	7
NH3-N	0.6	-	1.1
Fecal coliform[2]	30	-	4,500
Fecal coliform[2]	240	-	90,000
Oil and grease	5	-	6

---

[1] MWRA, 1989, Combined Sewer Overflow Draft Facilities Plan, Technical Memorandum 3-10, prepared by CH2M-Hill Team, Boston, MA

[2] Units in no./100 ml

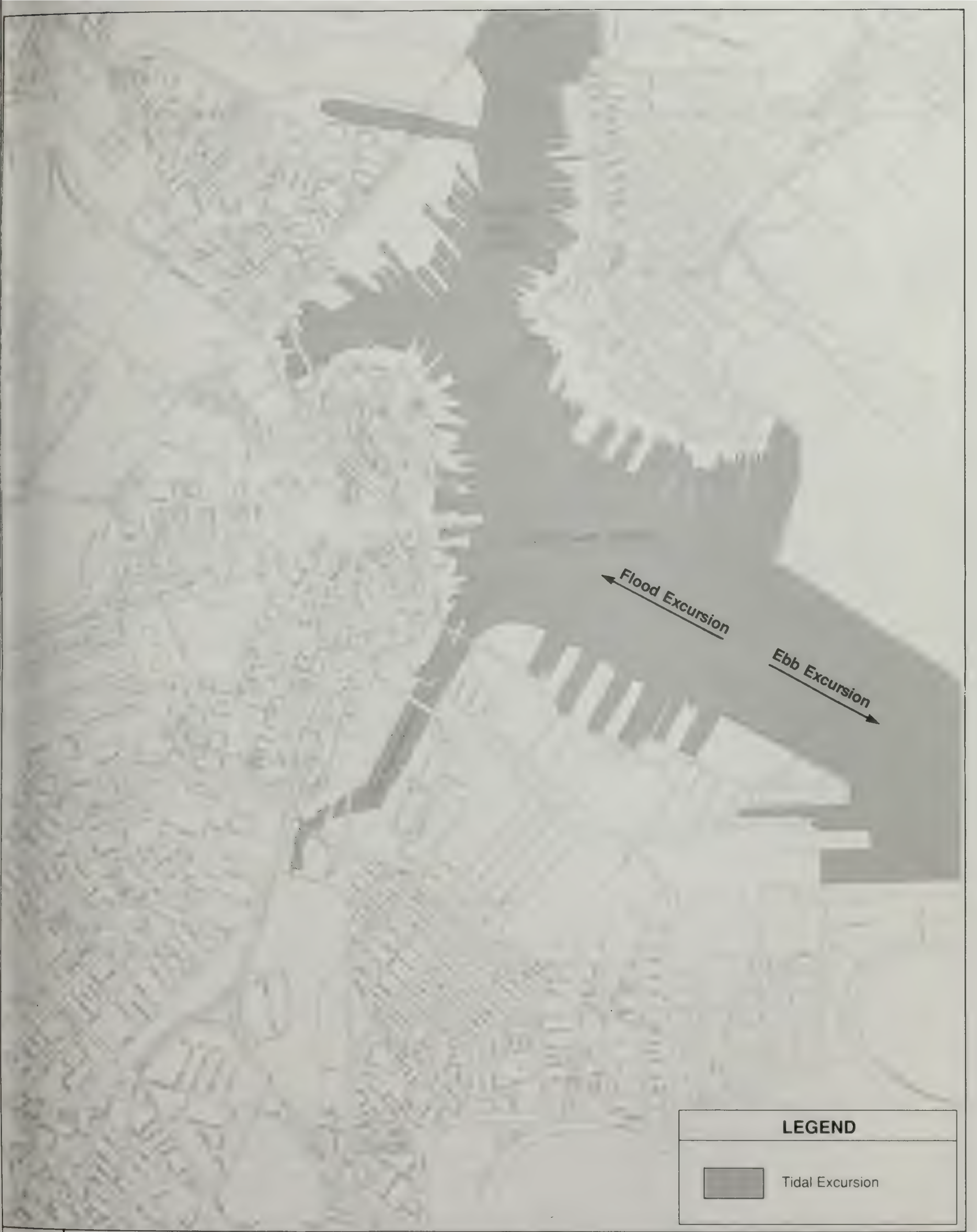


FIGURE 13.5 **Tidal Excursion**

COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Additionally, freshwater discharges from the Charles and Mystic Rivers can have a marked effect on the salinity of the Inner Harbor.

13.1.2(c) Sediment Quality

During January 1987, sediment cores were collected along the proposed Third Harbor Tunnel alignment between the South Boston bulkhead and the Bird Island Flats dike (Dredged Material Samples 1 and 2). (Locations of the environmental borings are shown on Figure 13.6.) These samples were tested for bulk sediment characteristics and subjected to bioassay and bioaccumulation testing in order to determine their suitability for ocean disposal. The depths of the sediment cores range from 1.4 feet to 6.0 feet below bed level.

The data (see Table 13.6) indicate that the sediments are uncontaminated to slightly contaminated by such metals as arsenic, chromium, copper, mercury, lead, and zinc. Contaminant levels in samples collected from the South Boston side of the ship channel contained the higher levels of metals, oil, and grease. The analyses also show the sediments contain PCB, nickel, and cadmium levels which meet the Massachusetts Category I criteria for chemical classification of dredged materials. Levels of other parameters indicate slight contamination at a Category II level in the sediments.

Additional sampling was conducted during November 1989 to determine the distribution of polyaromatic hydrocarbon (PAH) compounds in sediments along the proposed Third Harbor tunnel alignment. Three composite surface samples were analyzed, each consisting of three discrete samples (see Figure 13.7). The only PAH compounds and concentrations found in the sediments are shown in Table 13.7.

The chronic bioassay tests indicated the sediments sampled to be nontoxic. The U.S. Army Corps of Engineers (USACE) has reviewed the bioassay data for the sediments along the FEIS/R Tunnel alignment South Boston and Bird Island Flats, and has notified the Department in correspondence dated September 22, 1988, that the material has met the criteria in 40 CFR Parts 220-227 for disposal of dredged material in ocean waters. Though the tunnel alignment presently proposed differs slightly from that of the FEIS/R, it is in such close proximity to the previous alignment that it is unlikely that there will be any differences in sediment quality.

In addition to the above sediment quality data, there is a variety of other data on sediment chemistry from Boston Harbor including that from Jason M. Cortell and Associates Inc., 1980; U.S. Department of Transportation-Massachusetts Department of Public Works, 1982 and 1985; Metcalf & Eddy, 1984; Boehm *et al.*, 1984; National Oceanic and Atmospheric Administration, 1987; U.S. Army Corps of Engineers, 1988; and Shiaris, 1986. These sources will provide the interested reader with other information on sediment chemistry that is less project-specific.

13.1.2(d) Marine Life

Through a combination of general environmental studies on the Inner Harbor and studies conducted as a part of the SEIS/R for the Third Harbor Tunnel, 90 benthic macroinvertebrate species have been identified in the Inner Harbor. Pollution-tolerant polychaete worms such as *Capitella capitata* and *Polydora ciliata* dominate the benthic community.

Nearly 4 dozen species of finfish have been observed in Boston Harbor waters. One of the most common inhabitants of the Harbor is the winter flounder which spawns and remains in

Table 13.6

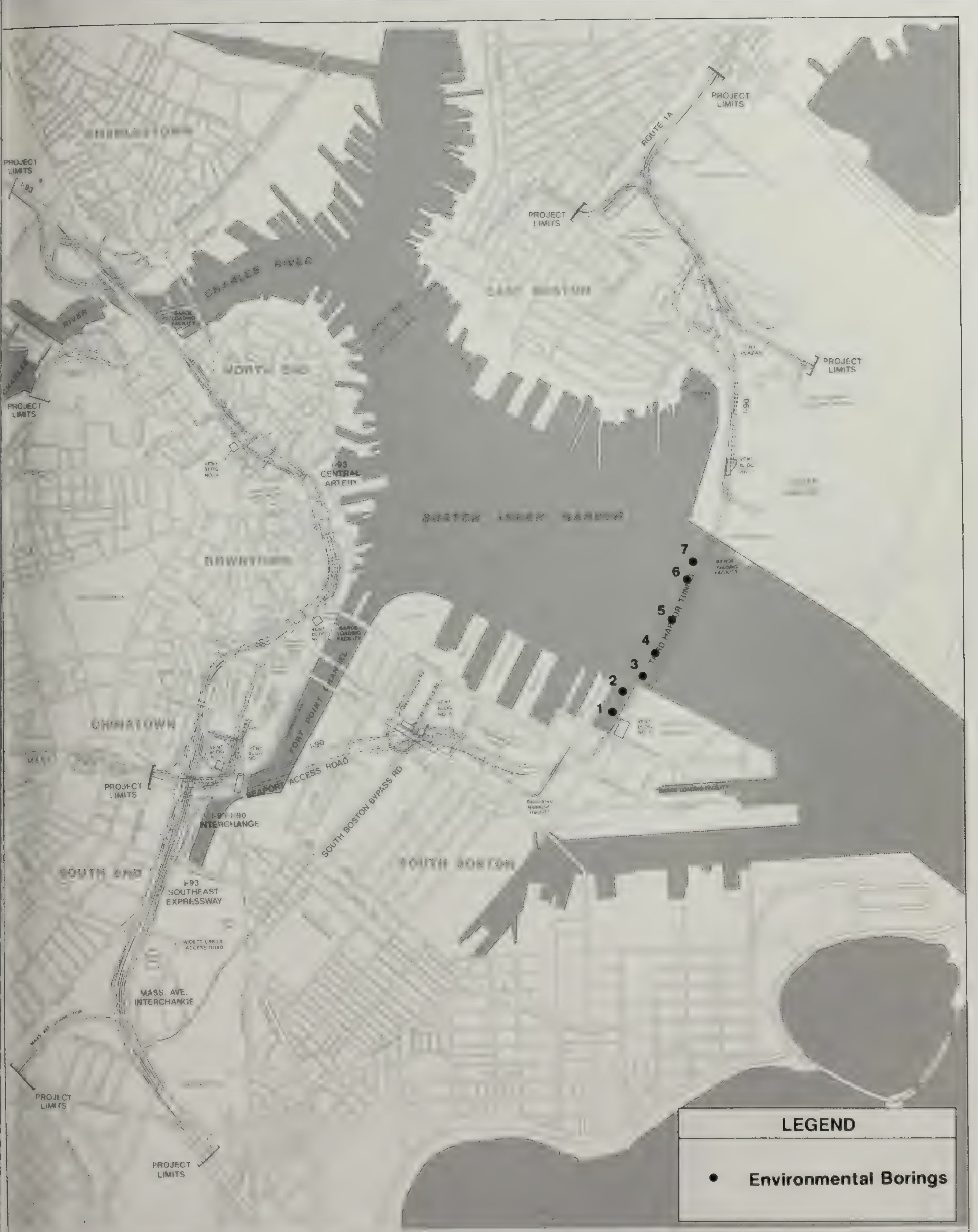
BULK SEDIMENT CHARACTERISTICS NEAR THE THIRD HARBOR TUNNEL ALIGNMENT

	Dredged Material	
Parameters[1]	**Sample 1[2]**	**Sample 2[3]**
Arsenic	11	8.5
Cadmium	3.0	2.3
Chromium	240	220
Copper	240	200
Lead	180	130
Mercury	0.81	0.84
Nickel	38	31
Zinc	300	230
PCBs	0.16	0.33
Oil and grease (wt.%)	0.16	0.09
Volatile solids (wt.%)	9.16	9.25
Water content (wt.%)	70.9	67.7
Grain size distribution (wt.%)		
Sand (≥0.0625 mm)	12	17
Silt (0.0625 - 0.0039 mm)	55	51
Clay (<0.0039 mm)	33	32

---

1. Concentrations in ppm dry weight unless stated otherwise
2. Composite sample from locations 1, 2, 3 and 4 (Figure 13.6)
3. Composite sample from locations 5, 6 and 7 (Figure 13.6)

Source: Massachusetts Department of Public Works, May 1988, Disposal Site Screening Dredged and Excavated Materials, prepared by: Jason M. Cortell And Associates, Inc.

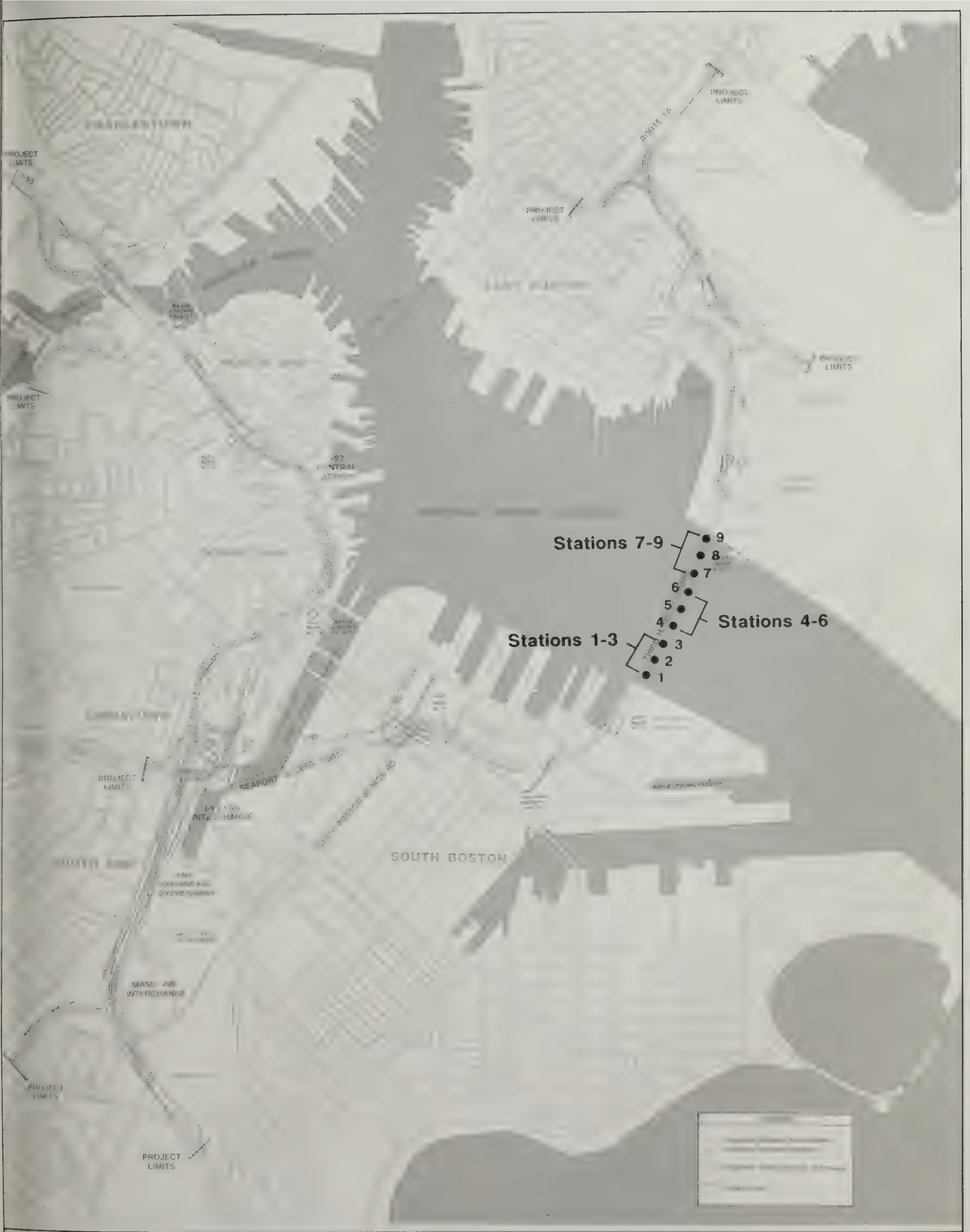


FIGURE

13.6 **Location Of Environmental Borings In Boston Inner Harbor**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet



FIGURE

13.7

Polyaromatic Hydrocarbon (PAH) Sampling Stations

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

Table 13.7

POLYAROMATIC HYDROCARBON CONCENTRATIONS IN THE THIRD HARBOR TUNNEL ALIGNMENT

Compound	Station 1-3	Station 4-6	Station 7-9
Benzo fluoranthene	ND[1]	1.60 ppm	1.50 ppm
Benzo (a)pyrene	0.54 ppm	ND	0.49 ppm
Indeno (1,2,3-CD) pyrene	ND	0.60 ppm	0.62 ppm
Benzo (G,H,I) perylene	ND	0.50 ppm	0.54 ppm

---

1. ND: Not detected

Source: Jason M. Cortell and Associates, Inc.

such areas as Dorchester Bay and the Outer Harbor year-round. Finrot disease has been reported to be common on flounder and is attributed to the overall poor water quality condition of the Harbor. Public fishing takes place at many publicly accessible locations within the Inner and Outer Harbors. Anadromous fish (ocean fish that spawn in fresh water) include smelt, alewife, herring, striped bass, and shad. Because of pollution abatement in the Charles River watershed, the potential for a shad fishery has improved significantly. Over the past 2 decades the Massachusetts Division of Marine Fisheries has undertaken a shad restoration program in the Charles River by stocking and construction of fishways in the dams. As a result of pollution abatement and fish restoration efforts, the extent of the anadromous fishery has increased substantially.

Both green and brown algae are common within the Inner Harbor growing on riprap and piles. The most frequent species include *Fucus* (rockweed), *Ulva* (sea lettuce), and a number of filamentous algal species.

Species of marine mammals periodically found in the Harbor include the harbor seal, harbor porpoise, and grampus.

13.1.3 Lower Charles River And Millers River

13.1.3(a) Hydrographics

Following construction of the new dam and locks in 1976, tidal fluctuations within the Lower Charles River were effectively eliminated. The locks are used to permit vessels to move between the Charles River and the Inner Harbor.

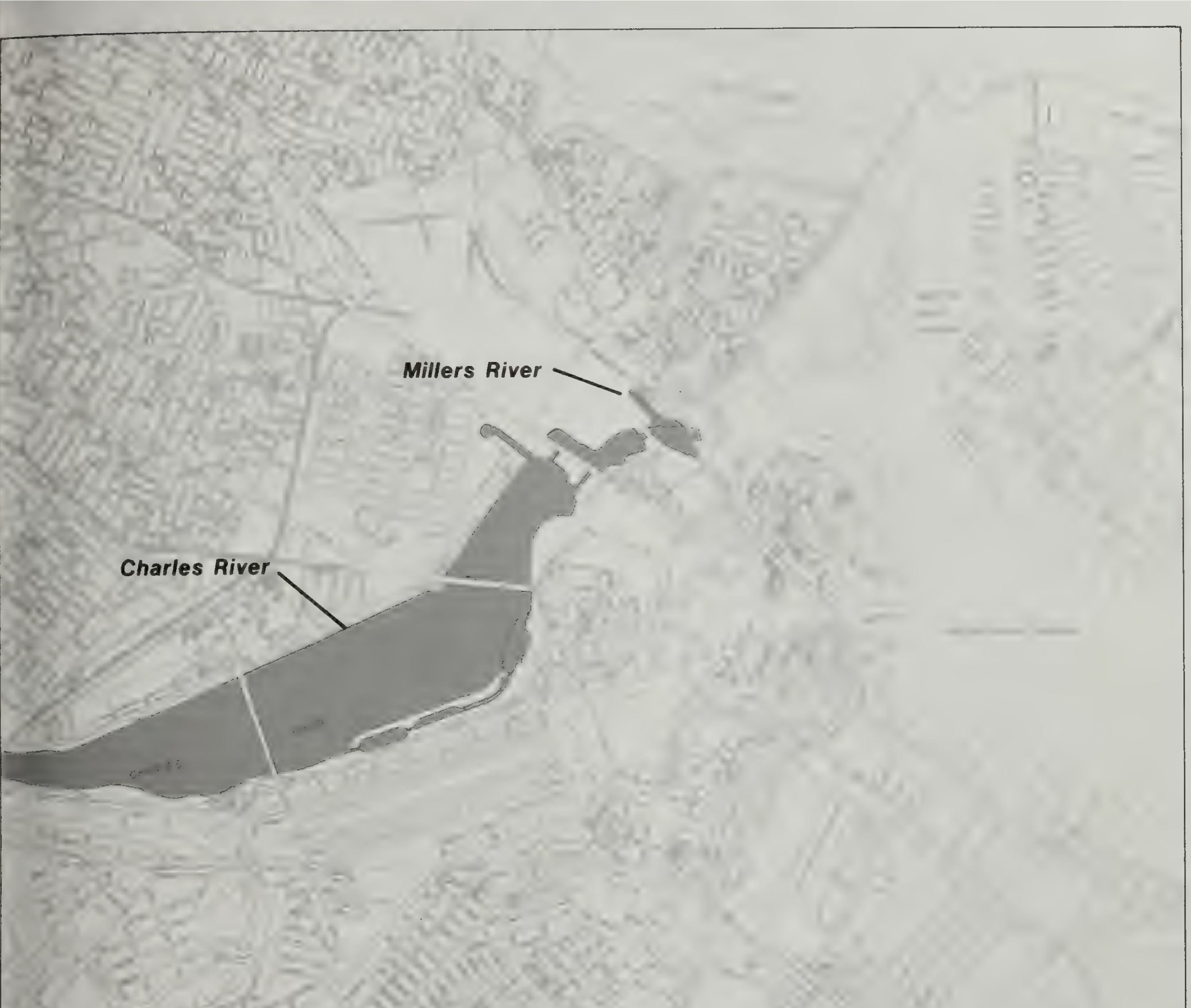
Fresh water from the Charles River drainage basin flows continuously through the spillways and locks of both the old and new dams before entering the tidally influenced Boston Inner Harbor. The mean annual flow from the Charles River is approximately 450 cubic feet per second (cfs), and the 7-day, 10-year low flow is approximately 22 cfs. The new dam is operated to maintain constant water depth in the Charles River. The dam is part of the flood protection measures for the low-lying areas of the Boston region. During storm events a large pumping station located at the dam is activated to evacuate large volumes from the Charles River Basin to prevent flooding.

The Millers River (see Figure 13.8) drains approximately 1,000 acres. The mean annual flow in the river is approximately 3 cfs and the 7-day, 10-year low flow is less than 0.1 cfs. The Millers River functions largely as a drainage channel for the approximately 1,000-acre drainage basin, and the main flow contributions from the Millers River occur during storm events.

The Millers River hydrologic, hydraulic, and hydrographic conditions are normally controlled by backwater from the Charles River. Therefore, the water fluctuations in the river are determined by the elevation of the Charles River. The Millers River flows through two 84-inch culverts located approximately 900 feet upstream of the Charles River dam and flood control pumping station.

13.1.3(b) Water Quality

The Lower Charles River is classified by the DEP/DWPC as Class C. Class C waters are designated for secondary contact recreation, and the protection and reproduction of fish, aquatic life, and wildlife (the minimum Class C water quality standards are given in Table 13.1).



FIGURE

13.8 **Location Of Charles And Millers Rivers**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

The most recent water quality data upstream and downstream of the new Charles River dam are available from the Metropolitan District Commission (MDC), the DEP, and the MWRA. The data suggest that Class C water quality standards are not consistently met, primarily due to wet weather CSO events (see Table 13.8). The DEP has designated the Charles River Basin above the new dam as NS (nonsupport), indicating that the standard is not met. According to the DEP, the Charles River Basin's water quality problems are high fecal coliform counts and low dissolved oxygen concentrations caused by CSOs, urban runoff, and sediments.

DEP/DWPC has classified the Millers River a Class B (the minimum Class B water quality standards are also shown in Table 13.1). Since water quality data for the Millers River were not available, a water quality sampling program was implemented in November 1989. Water samples were collected from the locations shown in Figure 13.9 and analyzed for general water quality parameters and metals. A summary of data obtained is shown in Table 13.9. Supplemental dissolved oxygen and temperature were measured and summarized in Table 13.10.

The water quality data indicate that portions of the river were found to have dissolved oxygen that was below the Class B water quality standard of 5.0 mg/l for a warmwater fishery. In addition, fecal coliform bacteria concentrations were high, exceeding the water quality standards. Hydrogen ion (pH) levels were within the Class B standard. Specific conductance and total dissolved solids concentrations indicated the water is fresh and not saline.

13.1.3(c) Sediment Quality

During 1988, sediment samples were collected from the Charles River at locations where bridge piers would be constructed. These samples were tested for bulk chemical quality and extraction procedure toxicity. (A data summary is contained in Table 13.11.)

Within a depth of 10 feet, the surface sediments have been found to be highly contaminated (Category III) with metals. The most notable elements are arsenic, cadmium, chromium, copper, mercury, zinc, and particularly lead. Surface sediments also contain high concentrations of sodium, petroleum hydrocarbons, and elevated concentrations of PCBs (Category III). A clear and rapid improvement in sediment quality (to Category I) was noted with increasing sediment depth, although mercury was still found at high levels (Category II) deep into the sediment. The results of the extraction procedure toxicity tests indicate the leachate was one to two orders of magnitude (10 to 100 times) lower than the EPA threshold levels for hazardous waste. Due to the results of the extraction procedure toxicity tests and the presence of PCBs at concentrations less than 50 mg/kg, the sediments would not be considered hazardous wastes for disposal purposes although potential upland disposal sites may be limited by requirements imposed locally or by landfill operators.

Sediment quality data for the Millers River are available in the DEP Water Quality Certificate Amendment for dredging in the river during construction of the Central Artery North Area (CANA) Project, and from additional sediment sampling conducted in November 1989. Figure 13.9 shows the locations of sediment sampling in the Millers River. The river bottom consists of more than 10 feet of organic oily muds. Sediment quality data for the Millers River are given in Table 13.12. These data indicate that the sediments are contaminated with petroleum hydrocarbons (0.2 to 1.2 percent), arsenic, chromium, copper, lead, mercury, and zinc in excess of the DEP Category I criteria.

Table 13.8

EXISTING WATER QUALITY IN LOWER CHARLES RIVER
(mg/l unless noted)

Constituent	1988 Sampling[1]		
Copper	0.0048	-	0.0813
Zinc	0.0031	-	0.0958
TSS	4	-	126
BOD	2	-	15
NH3-N	0.1	-	2.4
Fecal coliform[2]	20	-	105,000
Fecal coliform[2]	1000	-	960,000
Oil and grease	5	-	180

---

[1] MWRA, 1989, Combined Sewer Overflow Draft Facilities Plan, Technical Memorandum 3-10, prepared by CH2M-Hill Team, Boston, MA

[2] Units in no./100 ml

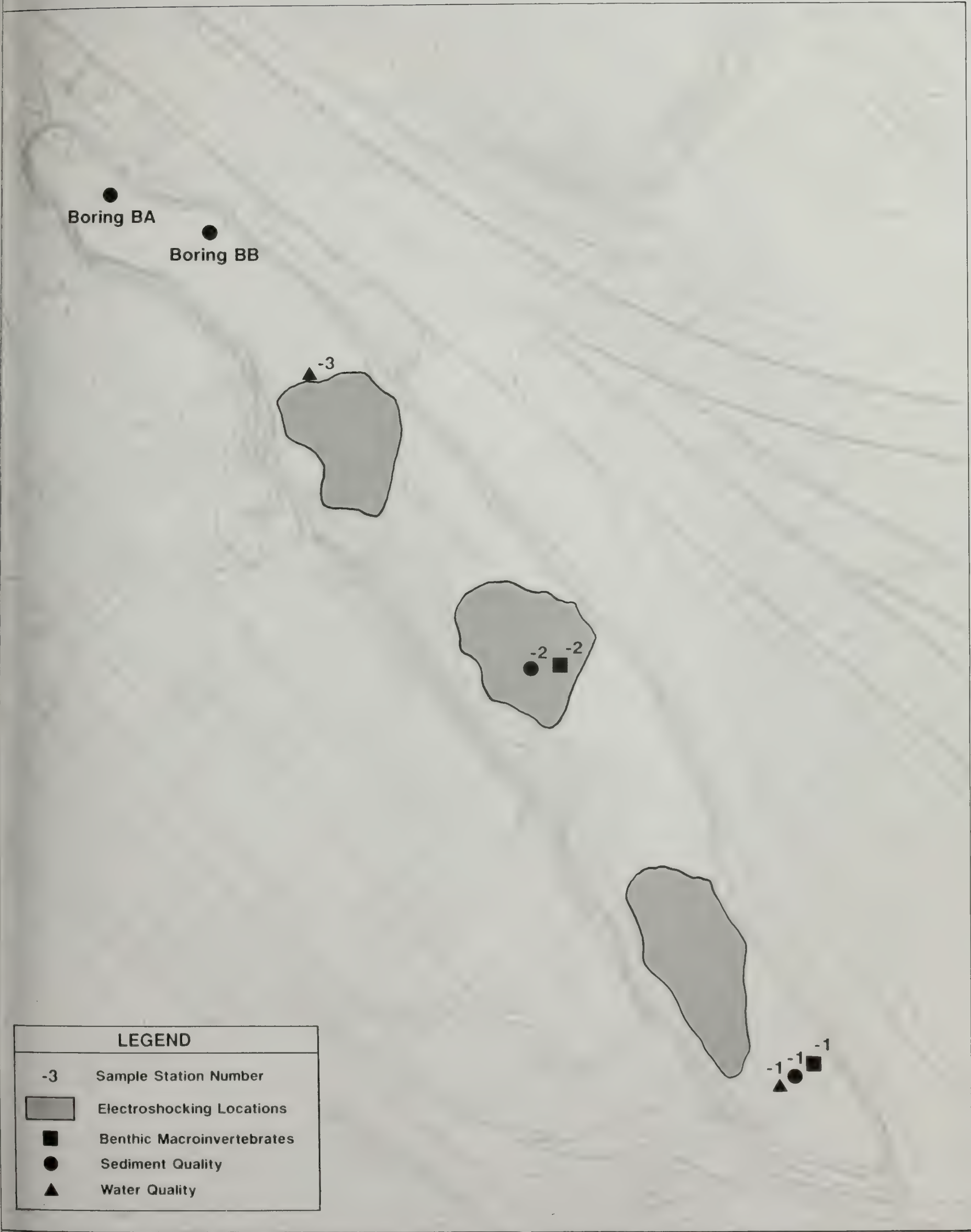


FIGURE 13.9

Millers River Sampling Stations

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 13.9

SUMMARY OF MEASUREMENT OF MILLERS RIVER WATER QUALITY PARAMETERS

Parameter	Station 1	Station 2	Station 3
pH (units)	7.3	-	7.00
Specific Conductance, umhos	650	-	800
Total Dissolved Solids	370	-	390
Total Suspended Solids	6	-	15
Ammonia Nitrogen	0.69		1.5
Total Kjeldahl Nitrogen	1.25		2.3
Total Phosphorus	0.10	-	0.08
Chloride	150	-	170
Total Coliform per 100 ml	6,300	-	12,000
Fecal Coliform per 100 ml	1,200	-	2,800
Arsenic	<0.005	-	<0.005
Cadmium	<0.01	-	<0.01
Chromium	<0.02	-	<0.02
Copper	<0.02	-	<0.02
Lead	0.006	-	0.008
Zinc	0.01	-	0.03
Biochemical Oxygen Demand	15	-	14
Total Cyanide	<0.04	-	<0.04
Total Organic Carbon	11.5	-	15.4
Temperature °C	10.5	11.0	11.0
Dissolved Oxygen	6.4	1.2	0.8

---

1. Results are in mg/l unless otherwise noted
2. Sampling locations are shown on Figure 13.9

Source: Jason M. Cortell and Associates, Inc.

Table 13.10

DISSOLVED OXYGEN AND TEMPERATURE MEASUREMENTS IN THE MILLERS RIVER

Date/Location of Sample	Temperature °C	Dissolved Oxygen (mg/l)
November 20		
Station 1	10.50	6.4
Station 2	-	1.2
Station 3	11.00	0.8
November 28		
Station 1	6.75	8.8
Station 2	6.75	6.8
Station 3	7.00	2.8

---

1. Sampling locations are shown on Figure 13.9

Source: Jason M. Cortell and Associates, Inc.

Table 13.11

LOWER CHARLES RIVER SEDIMENT ANALYSIS

	Depth Of Sample				
Parameter	0 to 10 Feet		10 to 14 Feet		17 to 22.5 Feet[1]
(mg/kg)	Average	Maximum	Average	Maximum	
Arsenic	13.5	37.5	14.1	32.1	4.2
Cadmium	13.3	32.2	0.8	1.1	1.4
Chromium	128.2	308	15.1	22.3	35.7
Lead	702	1,250	22	36.3	15.7
Mercury	2.7	6.7	0.7	2.6	1.0
Selenium	9.8	14.8	45	7.8	7.7
Silver	3.2	3.6	9.5	<0.5	<0.5
Copper	356.3	627	14.4	23.1	17.0
Nickel	38.7	58.1	14.8	24.6	19.0
Zinc	731.4	1,610	40.8	62.9	102
Antimony	78.8	100	44	73	34
Beryllium	0.8	0.8	<0.5	<0.5	<0.5
Thallium	8.5	10.6	3.9	6.3	6.7
Sodium	11,409	17,000	1,780	2,890	N/A
Chloride (%)	0.95	1.76	0.20	0.31	N/A
Petroleum Hydrocarbons	8,225	14,700	58.3	110	N/A
PCBs	1.5	5.6			
PAH Compounds	N/A	N/A	N/A	N/A	N/A
Benzo (a)	N/A	N/A	N/A	N/A	N/A
Anthracene	5.25	6.0	N/A	N/A	N/A
Benzo (a) pyrene	4.3	6.1	N/A	N/A	N/A
Chrysene	6.0	7.5	N/A	N/A	N/A
Fluroanthene	14.0	16.0	N/A	N/A	N/A
Phenanthrene	10.7	14.0	N/A	N/A	N/A
Pyrene	11.6	15.0	N/A	N/A	N/A

---

1. Represents one data point
2. Data compiled from Sampling and Chemical Analysis Program, Artery/Tunnel Project, Borings E-130 through E-135
3. N/A: Not available

Source: Soil Analysis Report, Jason M. Cortell And Associates, Inc., May 1989

Table 13.12

MILLERS RIVER SEDIMENT QUALITY[1]

Parameter	Station 1 0-1'	Station 2 0-1'	Boring BA[2] 0-9.5'	Boring BA[2] 9.5-15'	Boring BB[2] 3.0-15.0'
Water %	60	60	--	--	--
Volatile Solids%	--	--	7.82	15.2	14.4
Arsenic	14.6	17.7	--	--	--
Cadmium	2.2	3.0	0.79	2.3	0.79
Chromium	38.4	39.0	73	170	80
Copper	140	220	30	130	83
Lead	300	440	49	290	350
Mercury	0.82	1.08	0.10	1.2	0.98
Nickel	23.6	28.3	--	--	--
Zinc	400	600	--	--	--
Oil and Grease %	--	--	0.16	0.61	0.14
Petroleum Hydrocarbons	2,200	12,000	--	--	--
Total Organic Carbon	86,870	12,000	--	--	--
Total PCB	0.12	0.17	0.10	2.0	0.20
Anthracene	2.10	4.10	--	--	--
Fluorenthene	4.10	2.40	--	--	--
Pyrene	2.70	2.50	--	--	--
Benzo(a)pyrene	1.80	1.40	--	--	--
Indo(1,2,3CD)Pyrene	1.10	0.79	--	--	--
Benzo(G,H,I)Perylene	0.76	0.94	--	--	--
Napthalene	0.23	ND	--	--	--
2-methylnapthalene	1.50	2.60	--	--	--

---

1. The concentrations units here are in parts per million (ppm) unless otherwise indicated
2. Sample locations are shown in Figure 13.9
3. ND: Not detected

Source: Commonwealth of Massachusetts, Department of Environmental Quality Engineering,
Water Quality Certificate/Chap. 91
Application No. 86W-073N (CANA Project), September 25, 1986

13.1.3(d) Marine Life

While there are no site-specific data on the benthic community of the Lower Charles River, pollution-tolerant worms are believed to be the dominant species based on the low dissolved oxygen in the bottom of the water column, and the degraded sediment conditions. A November 1989 benthic survey of the Millers River identified an absence of benthic organisms.

A warmwater fishery is present upstream of the new Charles River dam. During July 1981, the Massachusetts Division of Fisheries and Wildlife conducted a fishery survey near the Boston University bridge. In order of abundance, the fish found in the sampling included golden shiners, white perch, alewife, pumpkinseed, yellow perch, white sucker, white catfish, northern pike, chain pickerel, and brown bullhead. Growth rates were reported to be excellent, and the condition factor was comparable to the Statewide average. Some of these species are also likely to be found between the old and new dams.

Anadromous fish (seasonal migrating fish) that pass into the Charles River via a fish ladder in the dam include smelt, herring, and alewives. It is also noted that the Charles River contains one of the three or four largest alewife and river herring runs in the State.

On November 28, 1989, the Millers River was sampled for fish using electroshocking techniques. Approximately one-third of the river was electrofished as shown in Figure 13.9. No fish were found.

In addition, sediment samples were examined for the presence of benthic macroinvertebrates. While over 10 gallons of sediment collected at the two locations shown on Figure 13.9 were passed through a 0.5-millimeter sieve, only one sludge worm *(Tubifex tubifex)* was found. It is concluded that water quality and sediment conditions in the Millers River are so degraded that they preclude the growth and survival of fish and macroinvertebrates.

13.1.4 Industrial Water Use

A survey of industrial seawater users in Fort Point Channel and the Inner Harbor where construction activities are planned was conducted to determine whether these users would be adversely affected during and subsequent to construction of the proposed project. Industrial saline water uses include noncontact cooling, washdown, and lobster and aquarium support. Saline water users adjacent to the alignment are shown on Table 13.13, and their respective locations are illustrated in Figure 13.10. Construction impacts on these uses are addressed in Chapter 20.

13.1.5 Groundwater

Groundwater is a concern because of the potential need to dewater during excavations and construction operations, and to equilibrate groundwater levels on each side of the proposed Central Artery tunnel box. Dewatering operations are addressed in Chapter 20, Summary of Construction Activity. Therefore, this section presents data on existing groundwater conditions in the project alignment related to groundwater levels.

The configuration of groundwater in the Boston area is complex due to the coexistence of native sand, till, and clay, and different types of non-native fill materials throughout the study area. It is also affected by the presence of various types of structures and

Table 13.13

INDUSTRIAL SEAWATER USE IN THE BOSTON HARBOR AREA

Name	Location	Primary Use	Maximum Daily Use (mgd)[1]
Fort Point Channel			
1. Gillette Company	Gillette Park South Boston	Cooling	57.6[2]
2. James Hook & Co.	15 Northern Avenue South Boston	Lobster Support	5.0
3. Neptune Lobster	88 Sleeper Street South Boston	Lobster Support	1.0
Boston Harbor			
4. General Ship	300 Northern Avenue South Boston	Fire Pumps	2.16
5. Massport/Bethlehem Steel Shipyard	265 Marginal Way East Boston	Cooling	0.28
6. Massport	Fish Pier South Boston	Washdown	0.43
7. Bay State Lobster	379 Commercial Street Boston	Lobster Support	4.32
8. Hines and Smart	33 Mill Street East Boston	Lobster Support	2.16
9. Harbor Lobster	Fish Pier South Boston	Lobster Support	1.44
10. Pauls Lobster	150 Northern Avenue South Boston	Lobster Support	1.5
11. Yankee Lobster	272 Northern Avenue South Boston	Lobster Support	0.86
12. New England Aquarium	Central Wharf Boston	Marine Aquarium	0.15

---

1. Millions of gallons per day
2. Present use is 37 mgd; stated capacity is 57.6 mgd

Source: Jason M. Cortell and Associates, Inc.

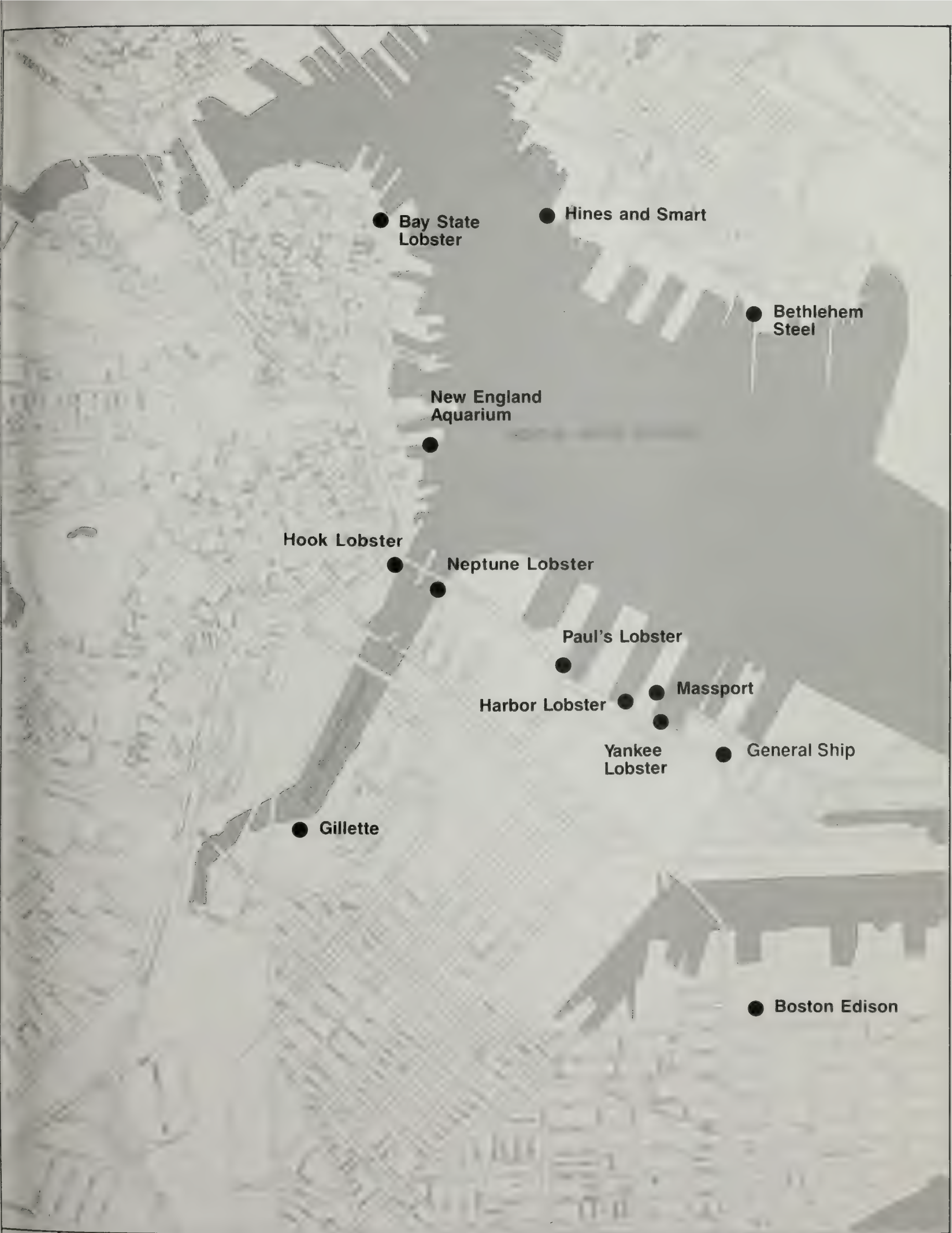


FIGURE
13.10

Major Users of Boston Harbor Water

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

underground utilities. Within Boston, groundwater recharge is generally derived from precipitation, the Charles River Basin, Muddy River (a tributary to the Charles River outside of the project area), and sewer and water main leaks, with the latter believed to be a large contributor (Cotton and Delaney, 1975). Additional recharge sources include stormdrains, MBTA tunnels, and associated underdrains (particularly in the areas of fill), infiltration from tidewater in the northeastern section of the Shawmut Peninsula (Cotton and Delaney, 1975), depressed roadways, building pumping systems, and construction pumping. Although recharge occurs, the project area is not considered an aquifer recharge area.

The construction of structures beneath the ground surface may artificially raise the water table if the structures are oriented such that groundwater flow is inhibited (Cotton and Delaney, 1975). On the other hand, since the project area is impervious in excess of 80 percent, the natural groundwater recharge from stormwater is very limited. Therefore, there is the potential that the water table will drop locally where structures inhibit recharge.

Recently, there has been concern in Boston over the lowering of the water table during and following construction dewatering activities. This results in the exposure and deterioration of wooden foundation piles supporting many of the older buildings, with the eventual result being ground and building subsidence (Haley and Aldrich, 1985; Cotton and Delaney, 1975). These concerns are addressed in Chapter 20.

The present use of groundwater in downtown Boston is negligible. In the past, an unspecified number of wells in downtown Boston (Shawmut Peninsula) were reported as having been shut down due to low yield, saltwater encroachment, or both (Halberg and Pree, 1950).

As a part of the data collection for the SEIS/R, 14 observation wells were installed in 1988 along the project alignment. These wells have been used to obtain samples of the groundwater for chemical analyses. In addition, there are 25 wells which were installed as part of a subsurface exploration program to obtain geotechnical data for preliminary design. All the wells currently are being used for monitoring groundwater elevations. Readings for the wells have been performed approximately every 2 weeks since January 1989.

13.1.5(a) Tidal Influences And Groundwater Levels

The coastal proximity of observation wells must be considered when evaluating groundwater levels because water levels can show fluctuations caused by the rise and fall of the tide. Since the tidal range for Boston is 9.5 feet, relative groundwater levels read from observation wells may be influenced by the tides near the shoreline.

Groundwater observation wells installed in this project have been surveyed relative to MSL and reveal groundwater levels ranging from 7.4 feet MSL to -0.4 foot MSL. Water elevations in almost all of the wells reflected differences in depth that cannot be associated with rainfall events and are directly attributable to tidal influence. This finding is attributed to the specific locations of the selected wells.

Additional groundwater studies related to the assessment of possible consequences caused by the tunnel structure to underground flows will be performed during the preliminary and final design phases of the Artery/Tunnel Project. This program will provide an evaluation of the severity of the potential impact of the proposed depressed section tunnel on groundwater levels, flow patterns, and quality, and on the existing wood pile foundation of buildings located in the vicinity of the project.

This program will include the following elements:

- Preparation of drawings for the existing piezometric levels in the project corridor and groundwater flow patterns and quality.

- Preparation of drawings showing the existing cutoff wall foundations and the proposed depressed section tunnel. These drawings will show the piezometric levels and flow pattern for the proposed condition.

- Evaluation of the severity of the potential project impacts on the groundwater and wood pile foundations.

- Preparation of conceptual and preliminary design drawings for proposed mitigation measures.

Since concerns about future groundwater conditions do not represent a rare instance in tunnel construction or in the City of Boston, a number of proven approaches are available for equalizing groundwater flow. The impact of the depressed Artery on groundwater levels is addressed in Section 13.2.3(b), and the applicability of the various solutions will be explored through the aforementioned study.

13.2 ENVIRONMENTAL CONSEQUENCES

The purpose of this section is to address the long-term impacts to water quality which could occur after the Proposed Action is constructed. Water quality impacts which could occur because of the material disposal program are discussed in Part II of the SEIS/R. Construction related impacts are discussed in Chapter 20.

The Proposed Action could affect the three surface water bodies described above after the completion of construction because of three types of activities: discharges of stormwater, tunnel drainage, and sewage to water bodies; placement of structures in water bodies; and placement of fill in water bodies. Urban stormwater runoff, tunnel drainage, and sewage impacts on all three water bodies are similar and will be part of the projectwide issues discussed in Section 13.2.4. The impacts of fill and structures on the individual water bodies are more localized and site-specific. These impacts are assessed in a separate section for each water body. The areas of the three water bodies potentially affected by long-term impacts from placement of fill and structures are shown in Figures 13.12, 13.13, and 13.14.

13.2.1 Fort Point Channel

Project structures and work to occur in or adjacent to Fort Point Channel are shown in Figure 13.15. Permanent elements include:

- The Seaport Access Road tunnel under Fort Point Channel. The top of the tunnel box, which will cross Fort Point Channel, will extend above the existing mud line by

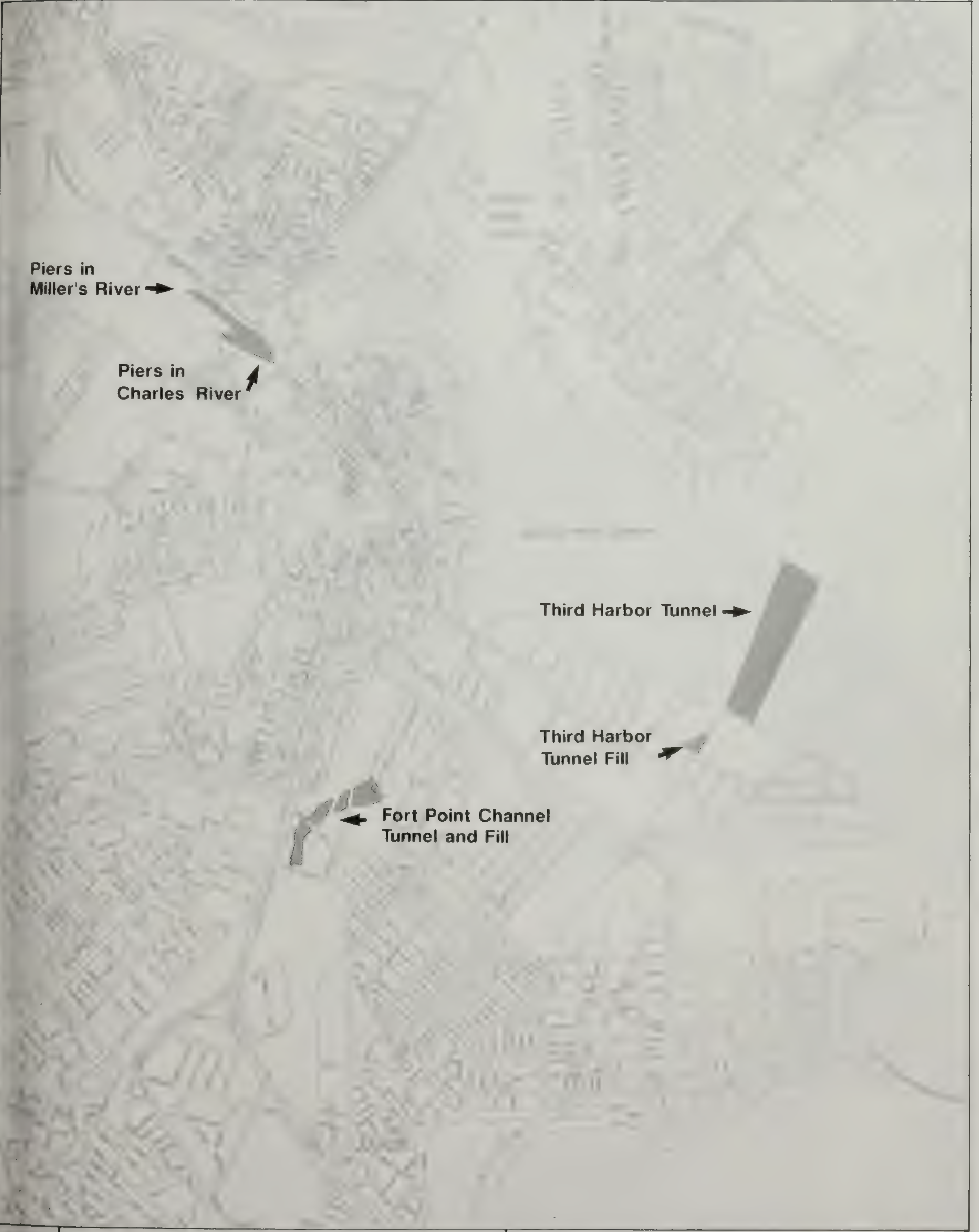
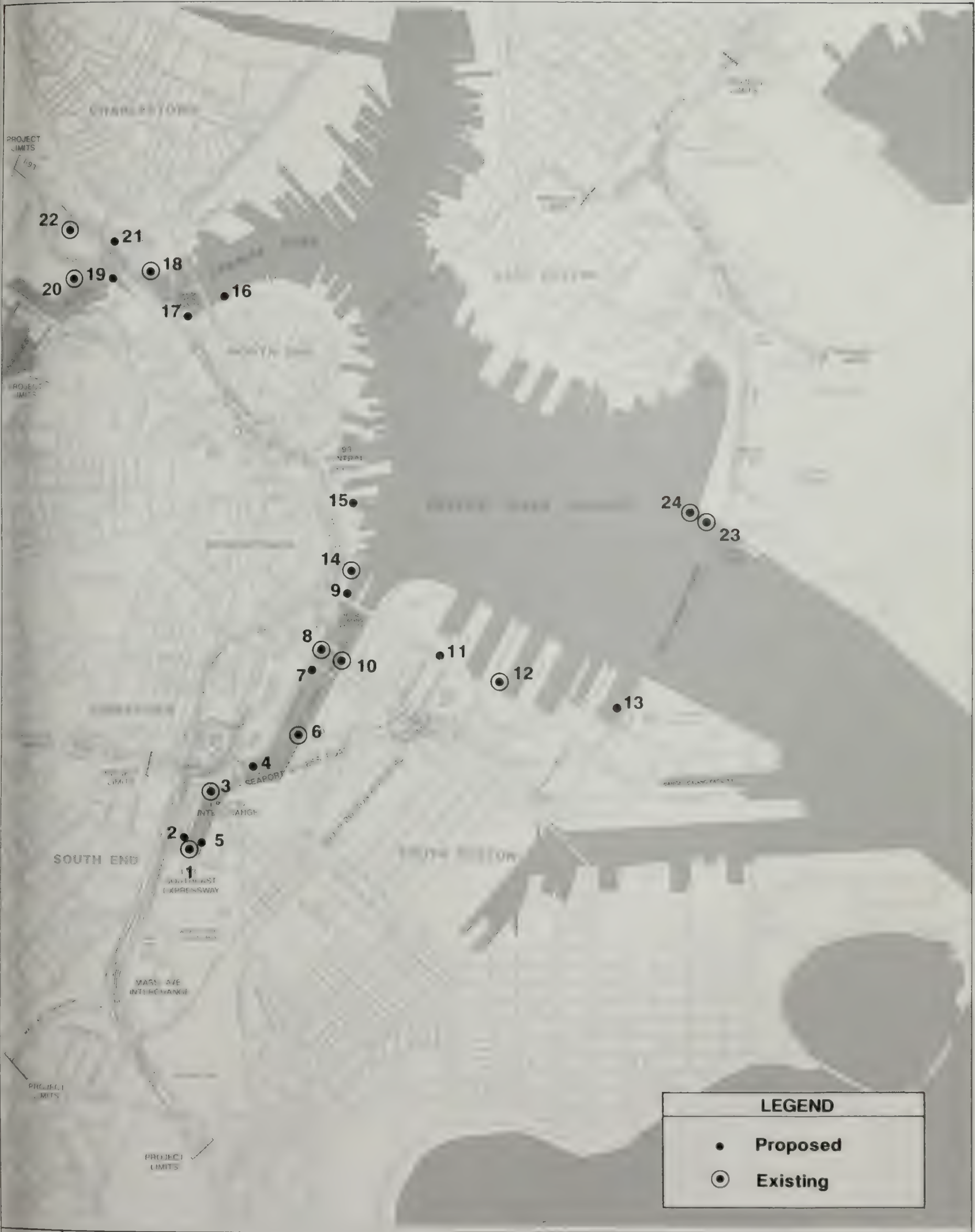


FIGURE 13.12 **Locations Of Activities In The Water**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



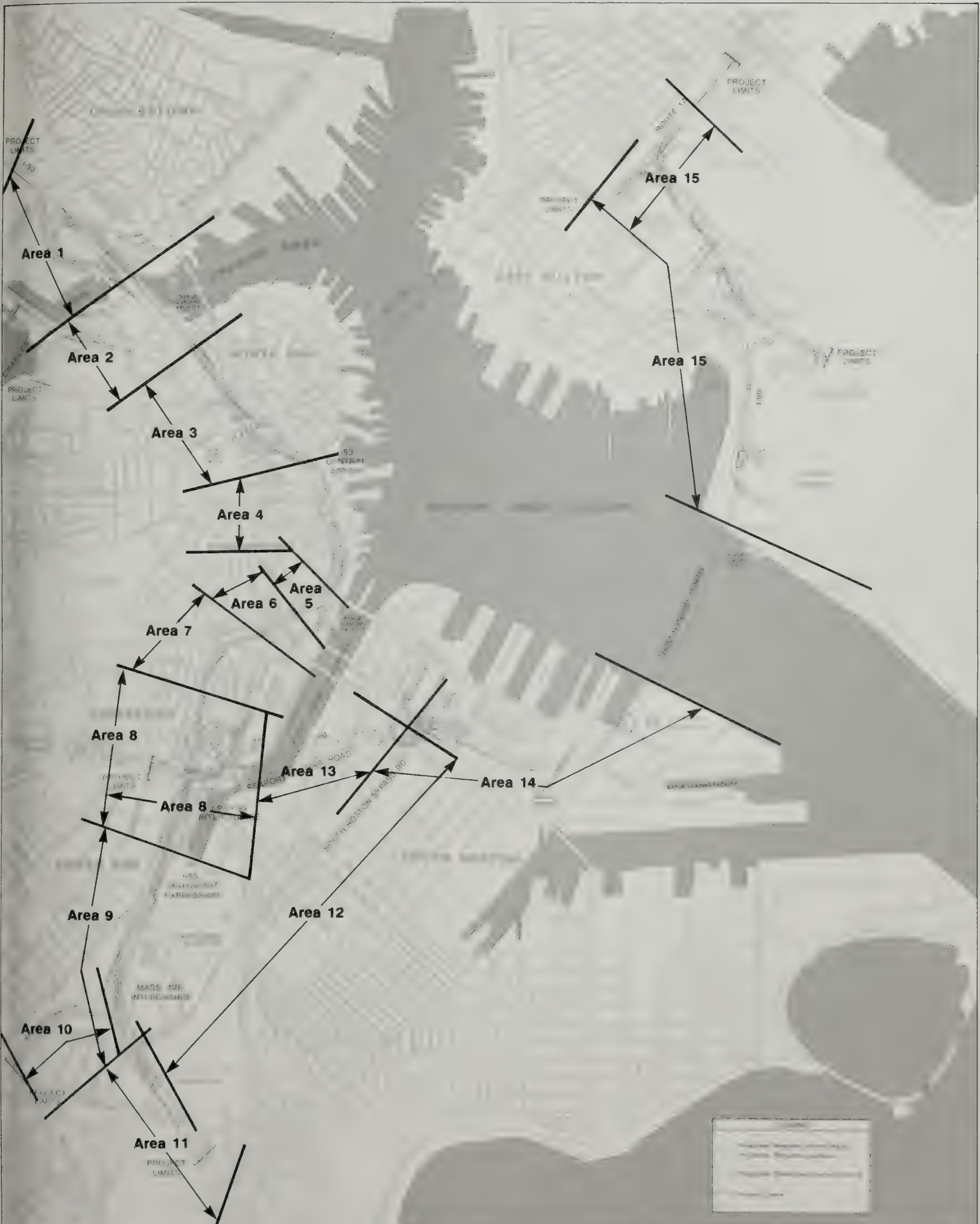
FIGURE

13.13

Proposed And Existing Outfall Locations

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet



FIGURE

13.14

Proposed Roadway Drainage Areas Schematic

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

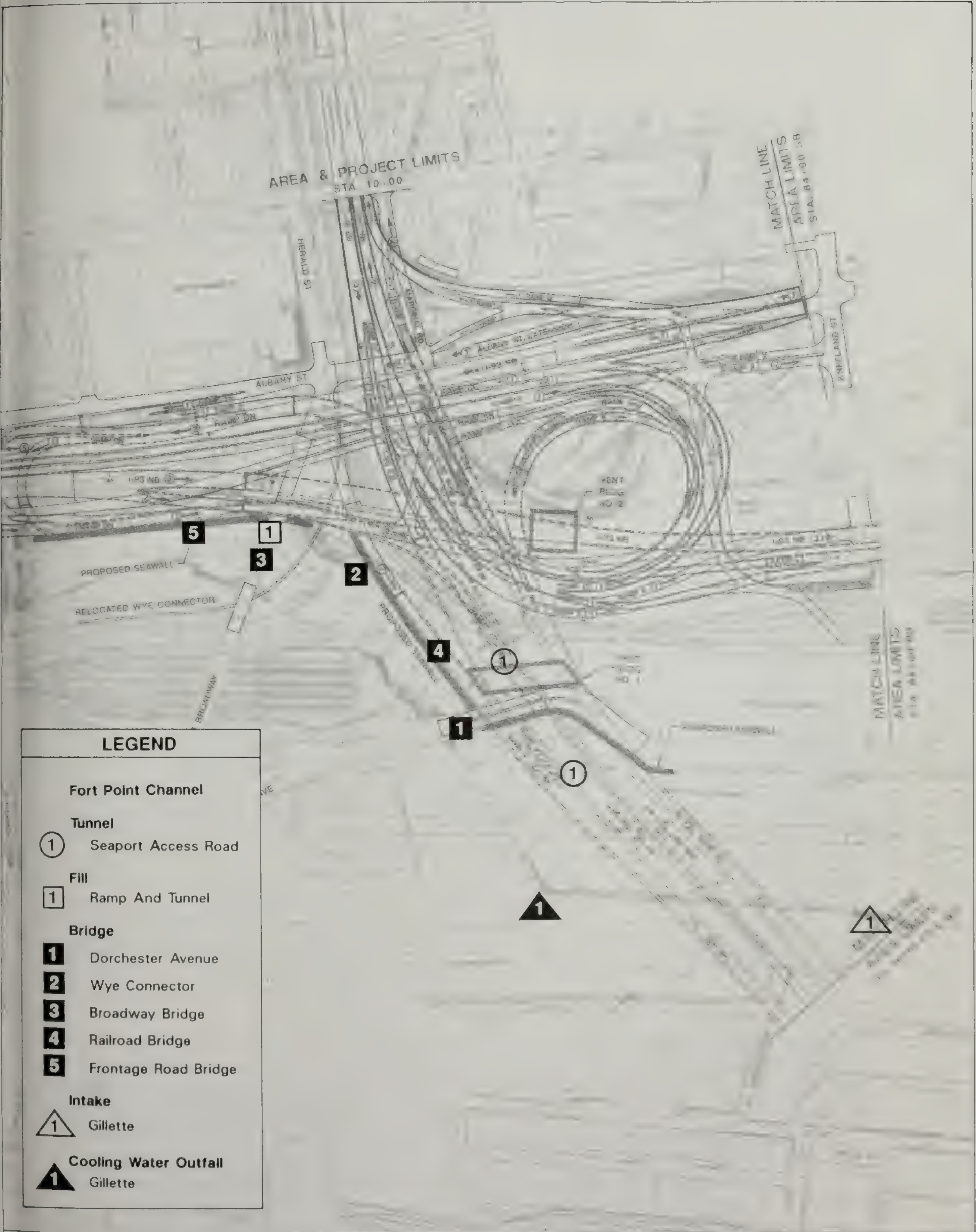


FIGURE 13.15

Proposed Structures Fort Point Channel

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800 Feet

approximately 9 feet, leaving 11 feet of freeboard at MLW. The elevation of this box is controlled by the MBTA Red Line tunnel, which runs down the center of the Channel, and the need to maintain flow in the Channel. The height of the tunnel box has been reduced as much as possible. The relationship of the proposed tunnel box to the mudline, therefore, cannot be changed. As will be discussed below, the effect of this tunnel box will be similar to a submerged weir across Fort Point Channel. (A profile and cross section of the Seaport Access Road tunnel box is shown in Figure 13.16.)

- New ramps and associated seawall along the western edge of Upper Fort Point Channel. The future seawall will be located 30 to 200 feet waterward of the existing seawall, depending on location.

- The removal of some existing bridges across Fort Point Channel (Dorchester Avenue bridge, railroad bridge, and Wye Connector).

- New bridges across Fort Point Channel associated with the new surface roadway system (Frontage Road northbound bridge, new Dorchester Avenue bridge, new railroad bridge, new Wye Connector, and modified Broadway bridge).

- Relocation of the existing cooling water intake for the Gillette Company.

The impact of the fill and structures associated with these activities on hydrographics, water quality, marine life, and sediment quality is addressed in this section.

13.2.1(a) Hydrographics

Construction of the ramps and new western seawall will require filling a portion of the western side of Upper Fort Point Channel, behind a bulkhead extending from Dorchester Avenue southwestward toward the end of the Channel. This will reduce the tidal water area and storage volume of Fort Point Channel from approximately 52 acres to approximately 49 acres, a reduction of approximately 5.8 percent. This reduction in tidal water volume will be reflected in a decrease in the tidal prism from 21.5 million cubic feet to 20.3 million cubic feet; the spring tidal prism will decrease from 24.9 million cubic feet to 23.5 million cubic feet. The tidal excursion for a particle of water beginning at the mouth of the Channel will decrease from approximately 2,100 feet to approximately 1,980 feet. Average tidal velocities at the Northern Avenue bridge will increase very slightly from approximately 0.10 fps to approximately 0.13 fps. The flushing time for the Channel will increase slightly, from 2.1 tidal cycles (approximately 26 hours), and therefore the flushing action will be slightly affected in the vicinity of the proposed fill and tunnel box to 2.12 tidal cycles (approximately 26.5 hours).

The proposed Fort Point Channel tunnel box will also result in sediments being deposited south of the tunnel box over time. At current sedimentation rates, it would require several decades to completely fill the basin in the Channel created on the south side of the tunnel box. The MWRA CSO treatment project, if implemented, may reduce the rate of sedimentation by reducing substantially a source of sediment, thus increasing the time-frame to fill the basin. While the tunnel box would be near the limit of navigation, it will not affect navigation in the Channel and, therefore, dredging is not expected to be required.

Water velocities over the tunnel box will increase because the cross-sectional area of the Channel at the tunnel box location will be reduced as a result of the proposed fill and box. The Channel in the vicinity of the box crossing, and the box, will be protected from erosion and scour so that the increased velocities over the top of the box will not cause changes to the shoreline. Additional studies and design of Channel protection features such as riprap slopes or gabion will be performed during the preliminary and final design phases.

The new bridges over the Channel, and the demolition of certain existing bridges, should have minimal impact on hydrographic parameters. Any new piers to be placed will have at most a minimal effect on water flow and circulation.

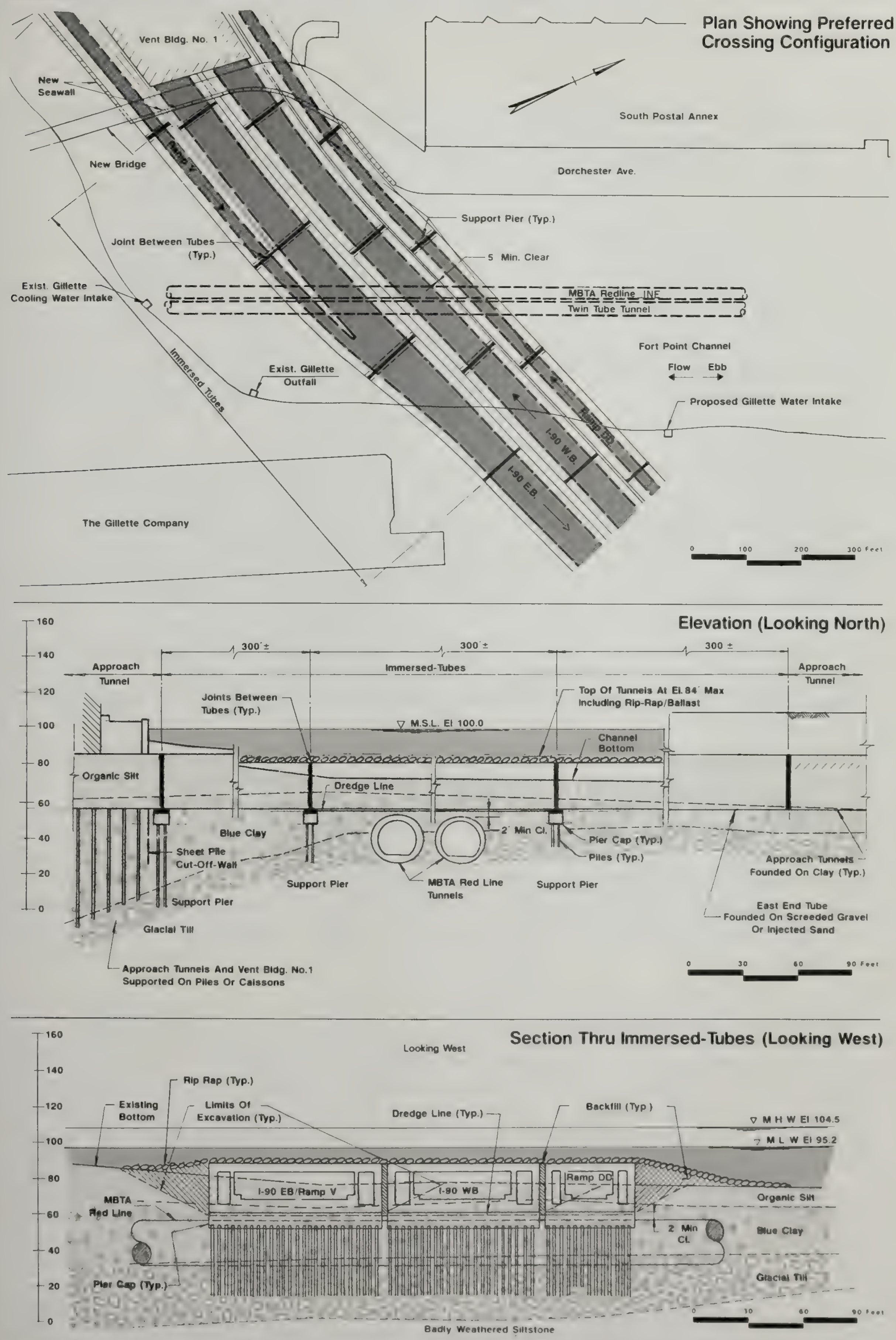
The placement of the tunnel box, in combination with fill in Fort Point Channel and in the vicinity of Dorchester Avenue, reduces the capacity of the Channel to pass flood flow, and may also affect flooding originated by runoff. Under existing conditions the tidal flow dominates the flow regime in the Channel. To assess the impact of the proposed fill and tunnel box on flood levels occurring during the 100-year design storm, a HEC-2 computer model was run to simulate the hydraulics of Fort Point Channel, and to find whether the runoff flooding conditions will worsen during the long-run postconstruction condition.

The model was run based on the following assumptions:

- o The 100-year peak discharge estimated is 6,500 cubic feet per second (cfs) using the Rational Method and time of concentration developed based on the Soil Conservation Service Medthod.
- o Starting water surface elevation at the downstream (seaward) reach is the mean high water level at elevation 4.58 above mean sea level (MSL).
- o Channel cross sections are based on soundings prepared in 1965. More recent soundings will be used to update the HEC-2 computer model shortly.
- o The 100-year tidal flooding elevation is at 10 feet above MSL as published in the Flood Insurance Study for the City of Boston, for Boston Inner Harbor.
- o Existing wood piles are removed from the Channel bottom.

Preliminary results of the HEC-2 computer model for Fort Point Channel show that the 100-year tidal flood elevation will not be impacted by the project, and that tidal flooding is still dominant under the postconstruction condition and the design flood of the 100-year storm rainfall. Based on these results it is concluded that the project will not have a long-term impact on flooding in the Channel. However, flow velocities in the vicinity of the area to be constricted by fill will increase from 2 fps to 6 fps for the 100-year event as compared to the existing condition. Therefore, Channel protection such as riprap will be needed to mitigate potential scouring impacts.

In conclusion, some hydrographic impacts to Fort Point Channel are expected. These impacts will result from proposed filling along the western edge of Upper Fort Point Channel, and the placement of a tunnel box structure acting as a submerged weir across the Channel. The filling will reduce flushing action. Also, the volume of the water body will be reduced by approximately 6 percent, and the tunnel will constrict full tidal flow, and cause slightly increased water velocities in the surface layers over the tunnel. To partially mitigate


Plan Showing Preferred Crossing Configuration

Elevation (Looking North)

Section Thru Immersed-Tubes (Looking West)

FIGURE 13.16 Plan, Profile And Cross-Section Of Seaport Access Road And I-90 Tunnel Box

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

these hydrographic and flushing impacts, abandoned piles and piers in the work areas near Dorchester Avenue will be removed, which will eliminate certain obstructions to flow and will therefore enhance flow and flushing. Riprap armor will mitigate for the increase in flow velocities. (Mitigation measures are summarized in Section 13.3.)

The project structures to be placed in and adjacent to Fort Point Channel may have an indirect effect on water quality during the postconstruction phase of the project. This consequence of the project will be manifested by changes to dilution and dispersion of those pollutants that are discharged to the Channel as a result of the proposed tunnel box. Measured by percentage change, the increase in flushing time, decrease in tidal prism, and changes in other hydrographic parameters are relatively minor. Since existing water quality in Fort Point Channel violates Class SC standards (see Section 13.1), these changes are not expected to cause new violations of water quality standards.

The more significant issue affecting the Channel water quality is the proposed diversion and treatment of the combined sewer flows that enter it, which is a part of the Boston Harbor Cleanup Program. Changes to the water quality of Fort Point Channel from the project are judged to be minor in comparison to this large upgrading effort. Work proposed in association with the Proposed Action will not interfere with implementation of the Boston Harbor Cleanup Program in Fort Point Channel.

The proposed filling of the Channel and the construction of the tunnel box would affect Gillette's existing cooling water loop without mitigation. In anticipation of these impacts, the Gillette cooling water intake will be located seaward of the proposed tunnel box, while the discharge will remain inboard of the tunnel box (see Figure 13.15). The performance of the cooling water loop may be improved as a result of the relocation of the intake. The box will reduce the recirculation of the cooling loop discharge.

The discharge outlets will remain on the nonharbor side of the tunnel box. Based on existing data, it appears that discharge water is generally stratified at the surface of Fort Point Channel and little mixing occurs with cooler tidal ebb flow. Therefore, the thermal plume variation from the outlet should vary after construction of the tunnel box. Postconstruction tidal ebb flow should not intermix the cooler bottom water with the surficial heated discharge.

13.2.1(c) Marine Life

Project structures and fill will permanently cover about 8.4 acres of existing benthic resource areas in the Channel. In addition, existing benthic communities in the depositional area to be created upstream of the tunnel box, under the Channel, will be overlain by sediment. Since the affected benthic ecology is highly stressed at the present by the Roxbury Canal Conduit and discharges from other existing combined sewer overflows (see Section 13.1), this temporary loss is not seen as significant. This condition will be partially mitigated by the new substrate to be created by the new seawall along the western shore of the Upper Channel, and the tunnel box passing under the Channel. After equilibrium is reached, the sedimentation area to be created above the crossing of the tunnel box will recolonize with appropriate, pollution-tolerant species.

If a portion of the flows from the CSOs that currently discharge into the Channel are collected and treated at Deer Island after completion of the MWRA project, the marine ecology may shift to one that is less adapted to pollution. The changes to be caused by the project will not hinder the establishment of an improved ecology, once the underlying causes of water quality degradation (including the CSO discharges) are addressed.

13.2.1(d) Sediment Quality

Project structures and fill will cover approximately 8.4 acres of existing bottom sediments. This fill will consist of materials free of unacceptable contaminants. This will result in an improvement of bottom sediment quality.

13.2.1(e) Conclusions

Major findings in this section are as follows:

- There is much less encroachment of the Channel proposed now than was the case in the FEIS/R.
- Encroachment of the Channel has been minimized to the maximum degree practicable.
- Project implementation will not interfere with the activities of others to improve the water quality of the Channel.
- There will be changes to Fort Point Channel, including the shifting waterward of bulkheads, the reconstruction of several existing bridges, and the placement of a roadway tunnel under the Channel whose top elevation will extend approximately 9 feet above the existing mudline, leaving 11 feet of freeboard at MLW. The impact on hydrographic, sediment, and marine life parameters appears acceptable, and project implementation will not cause significant degradation of receiving water quality.
- Studies of the effect of the submerged tunnel box on the existing thermal regime in the Channel are continuing. Preliminary indications are that, with the relocation of the Gillette cooling water intake seaward of the proposed box, and the retention of the cooling water discharge upstream of the box, the performance of Gillette's cooling system will be maintained, but there may be changes in the existing dilution and dispersion of the cooling loop effluent.

13.2.2 Boston Inner Harbor

Project activities proposed for Boston Inner Harbor are shown in Figure 13.17. The only permanent element is the tunnel under the Harbor, which has two separate features relevant to water quality. The first is the completely submerged segment to be placed under the Harbor (including the main shipping channel and an anchorage) between the Subaru Terminal and Logan Airport (Bird Island Flats). The second feature is the southern approach to the tunnel. The geometry of the latter requires filling a corner of the existing slip east of the General Ship dry dock in the Boston Marine Industrial Park. This filling is necessary because the roadway has to swing to the north, while simultaneously descending to sufficient depth to cross under the shipping channel.

13.2.2(a) Hydrographics

With the exception of a small (approximately 5,330 cubic feet) amount of intrusion into the tidal prism at the juncture of the rock fill dike for the Boston Marine Industrial Park and the seawall east of the General Ship dry dock (see Figure 13.17), the Third Harbor Tunnel will not encroach upon Boston Inner Harbor, but extend beneath it. The fill described above will have no measurable effect on Boston Harbor hydrodynamic features. In addition, construction of project structures within Fort Point Channel, Millers River, and the Lower Charles River will have no measurable, nor calculable, impact on the Harbor's present flushing rate (once every 50 hours), or any other hydraulic feature of Boston Harbor.

13.2.2(b) Water Quality

The Third Harbor Tunnel and the small amount of filling required to construct the southern approach will have a negligible long-term impact on water quality parameters. These structures will not release pollutants into the ambient waters, and their impacts on hydrographic parameters will be negligible, as described above.

13.2.2(c) Marine Life

Project fill in the slope just east of the General Ship dry dock will permanently cover about 3,145 square feet of existing benthic resource area. In addition, because the dredged tunnel trench will not be backfilled completely to reestablish the existing bottom contour, benthic communities in the vicinity of the Third Harbor Tunnel may be altered due to the slow deposition of sediments in the depression above the tunnel. The 3,145-square-foot loss is negligible in a regional context, and will be partially mitigated by the substrate to be created by the new seawall to be built in the corner of the slip. The modified benthic areas alongside the tunnel alignment will recolonize with species already present (see Section 13.1) after the equilibrium bottom contour is established. As time passes and the depression fills with sediment, the benthic community will adjust and will be similar to that which presently exists.

None of the changes described above will affect marine life in the water column.

13.2.2(d) Sediment Quality

Project fill will cover approximately 3,145 square feet of existing bottom sediments, and sediments adjacent to the Third Harbor Tunnel will be disturbed. Slowly the tunnel trench will fill with sediments, and a new equilibrium bottom, both in contour and in quality, will be established. These temporary changes to sediment conditions are viewed as minor.

Major findings in this section are as follows:

- After construction, the water quality in Boston Inner Harbor will be unchanged by the placement of the Third Harbor Tunnel.

- A very small amount of fill to be placed in the General Ship slip will result in negligible impacts.

13.2.3 Lower Charles River And Millers River

Project structures and work to occur in or adjacent to the Lower Charles River and the Millers River are shown in Figure 13.18. Permanent elements include:

- Three new bridges over the Charles River: I-93 northbound, I-93 southbound, and the Storrow Drive connector/Route 1 bridge. The I-93 bridges will be single-deck bridges, and the Storrow Drive connector/Route 1 bridge will be a double-deck bridge.

- Ramps and a cloverleaf structure east of and above the Millers River.
- Demolition of the existing Central Artery bridge over the Charles River.

13.2.3(a) Hydrographics

Three new bridges will be constructed over the Charles River west of the new dam, and the existing Charles River bridge will be demolished. All but one of the existing bridge piers will be demolished to the mudline to an elevation slightly above the water level. The site will be marked appropriately so that the remnant pier does not become a hazard to navigation.

A maximum of 17 new piers will be constructed in the Charles River to support the three new bridges (see Figure 13.19). These piers will be located upstream of the existing bridge, where the effective flow area is wider than where it is crossed by existing I-93. The new bridge support structures will be located far enough upstream so that any flow modifications that do occur, in spite of the pier placement outside of the effective flow area, will not affect the pumping station.

A maximum of eight new piers with 20- by 20-foot pile caps above the mudline will also be placed in the Millers River as a part of the new I-93/Route 1 interchange structure (see Figure 13.19). These new piers will affect approximately 3,000 square feet of existing river bottom.

The proposed three new bridges will require piers to support the superstructures or bridge decks. These piers will result in encroachment and a slight reduction of water storage in the Charles River. The storage lost will be offset partially by removal of piers and piles of the existing high level bridge. Since the proposed bridges area is hydraulically regulated by the large pumping station located at the new Charles River dam and the area downstream of the dam is tidal, the storage reduction immediately upstream of the dam will not affect the downstream flooding conditions. The compensation by creating new water storage by excavation does not appear to be effective. In addition, with its large pumping capacity the pumping station located at the dam is expected to handle the storage reduction.

The hydraulic impact on the Millers River is expected to be minor. Flows in the Millers River are presently constrained by the two 84-inch culverts at its mouth. The net flow areas at all locations of new piers will remain larger than the net flow area at the existing culverts. Therefore, it is anticipated that placement of the new piers in the Millers River will not have a practical effect on this stream.

In conclusion, there are several hydrographic concerns in the Charles and Millers Rivers area, but an examination of each concern shows that the project impacts will not affect the existing conditions.

13.2.3(b) Water Quality

There are no anticipated long-term water quality impacts associated with the placement of the piers in the Charles or Millers River.

13.2.3(c) Marine Life

Project structures and fill will permanently cover about 3,000 square feet of existing benthic areas in the Charles River, and about 3,000 square feet of existing benthic areas in

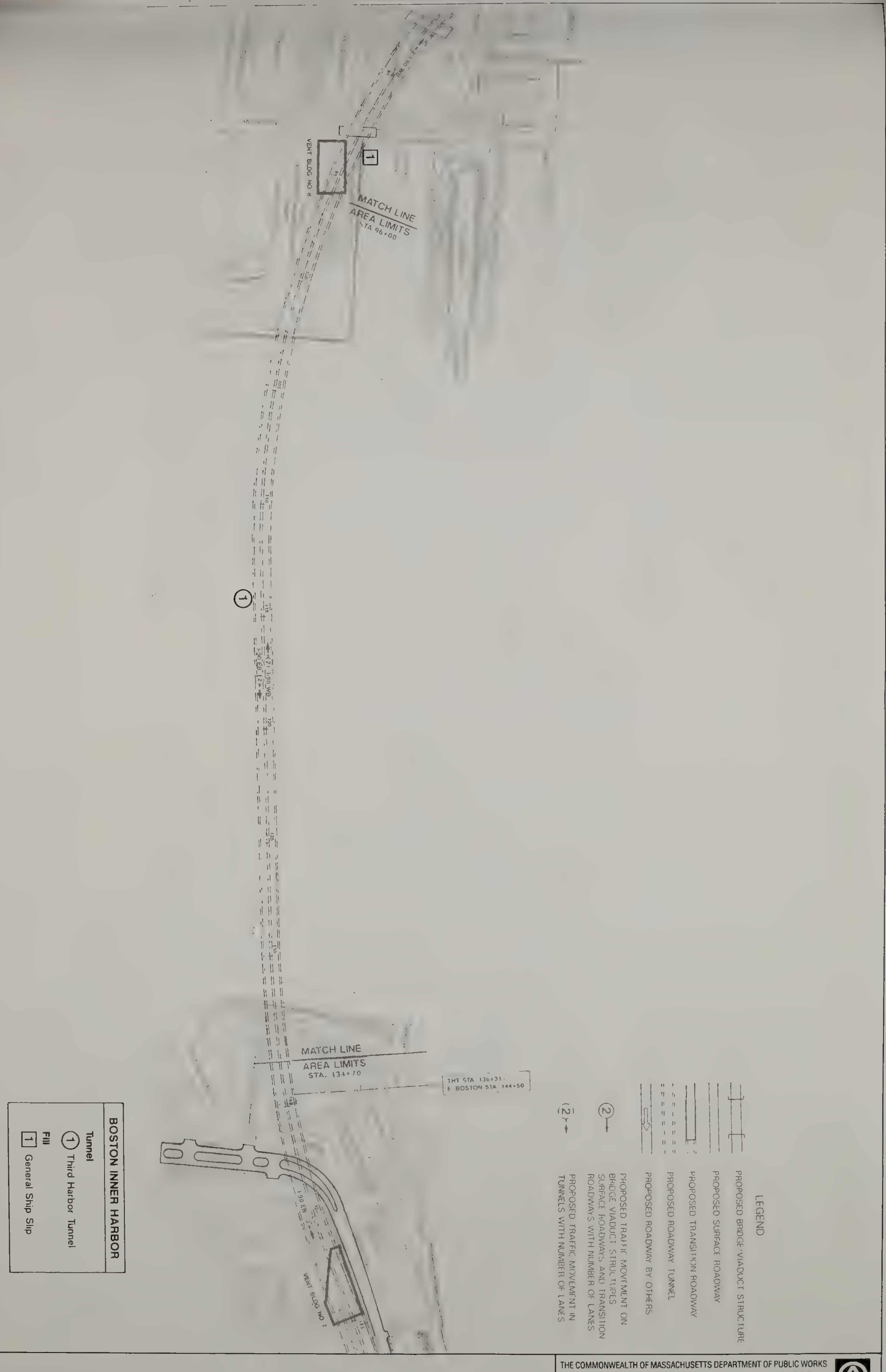


FIGURE
13.17

Proposed Structures And Fill: Boston Inner Harbor

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

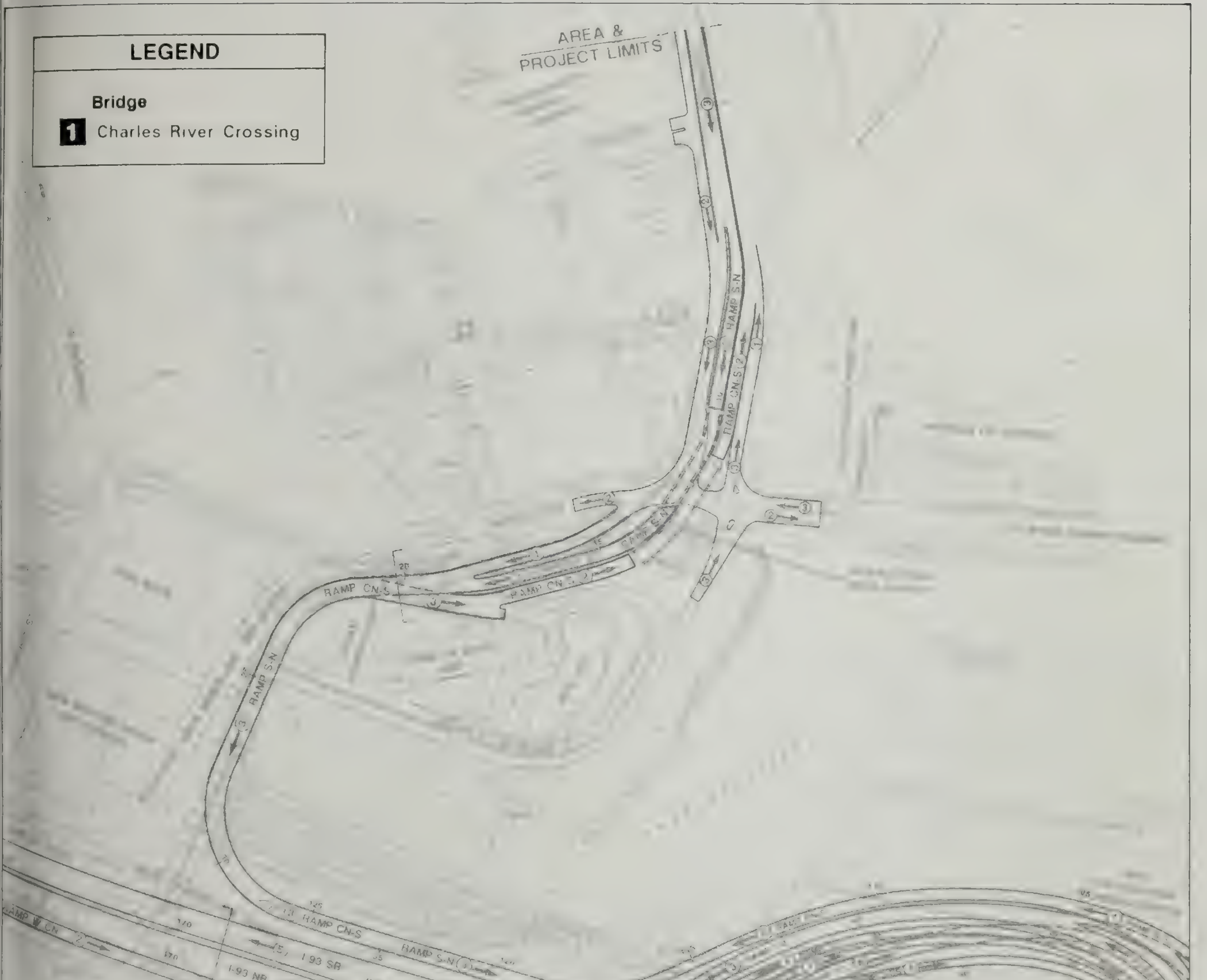
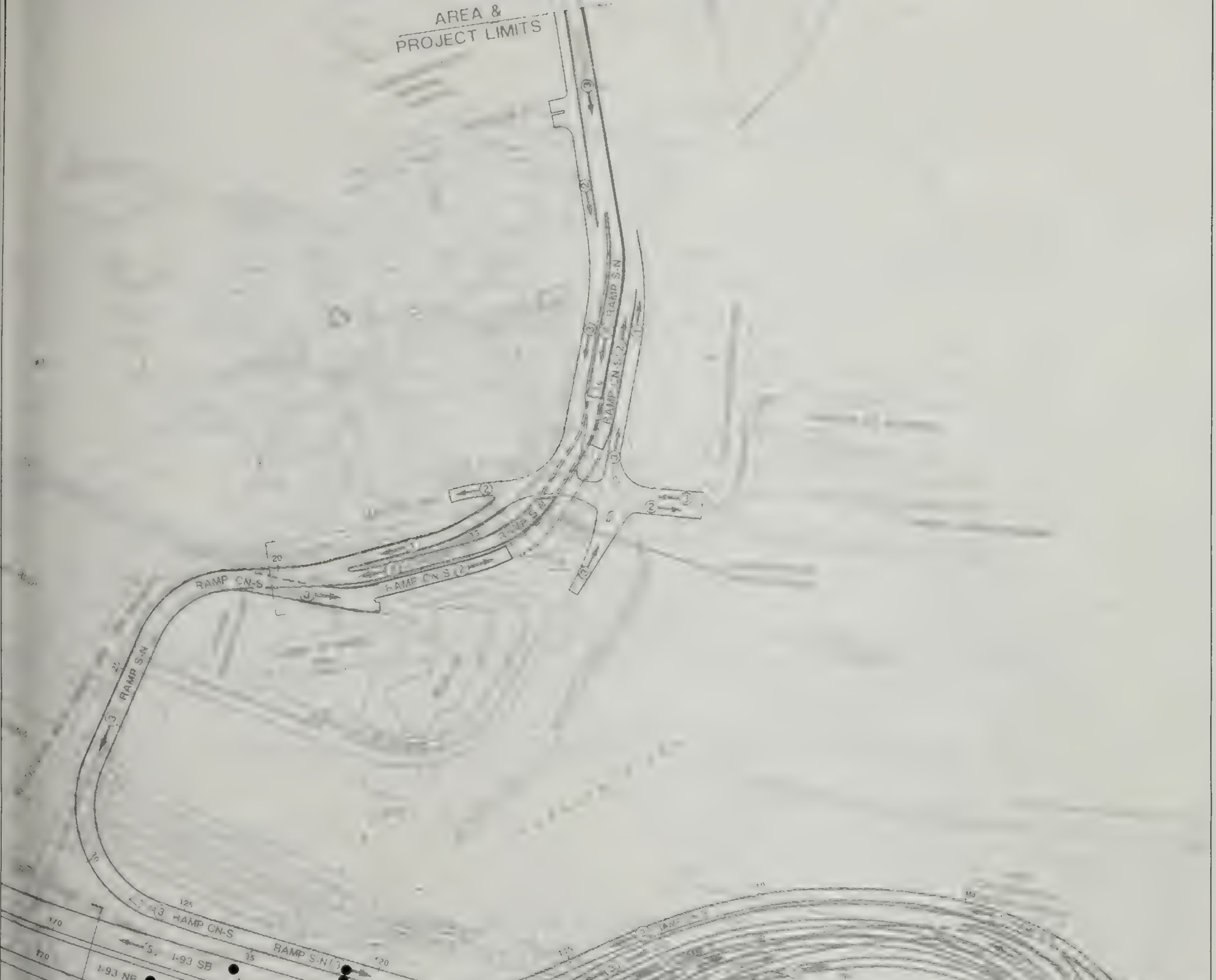


FIGURE 13.18 **Proposed Structures And Fill: Charles And Millers Rivers**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



FIGURE

13.19 **Bridge Pier Locations For The Proposed Charles River Crossing**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

the Millers River. On the other hand, the demolition of the existing Charles River bridge piers will clear about 3,500 square feet of bottom area in the Charles River which will become recolonized. Therefore, no net change is anticipated.

Since the affected benthic ecology in the Charles River is highly stressed, as evidenced by the dominance of pollution-tolerant worms, these losses are not major. The benthic ecology in the Millers River is even more stressed than the ecology in the Charles River because of the loading of suspended solids discharged by nonproject sources to the Millers River.

Although minor, the benthic losses in both rivers will be partially mitigated by the new substrate to be created by the submerged portion of the new bridge piers. Shading effects may cause some short term delay in shad migration, but should not cause any long-term impediment to normal fish behavior. [See Section 14.2.1(d), Aquatic Impacts, for further discussion.]

13.2.3(d) Sediment Quality

Project structures and total fill will cover approximately 6,000 square feet of bottom sediments in the Charles and Millers Rivers, although this will be offset by the 3,500 square feet of bottom area which will recolonize when the existing I-93 bridge piers to be demolished. The net loss of productive habitat is minimal and no change in sediment quality is anticipated.

Similarly, the sediment quality in the Millers River is not expected to change substantially.

13.2.4 Projectwide Issues

13.2.4(a) Project Effluents

There are two general categories of effluents which will be generated during the long-term operational phase of the project. These effluents (wastewater and sewage) are described in the following paragraphs.

Tunnel Wastewater. The first broad category of project effluent is wastewater. Wastewater will be generated in all tunnel sections of roadway. (Major tunnels include the Third Harbor Tunnel, the Seaport Access Road tunnel under Fort Point Channel, and the various cut-and-cover land tunnels within the project limits.) Figure 13.20 shows the location of roadway tunnel sections.

Tunnel wastewater includes tunnel washdown water, runoff from firefighting activities, mixtures of water and vehicle liquids released by accidents, and small amounts of stormwater entering the tunnel when stormwater flows accidently bypass the stormwater inlets in the approach ramps. Minor contributors to tunnel drainage include vehicle drippings, tunnel wall seepage, supply and exhaust air duct drainage, walkway drainage, and niche drainage.

The quality of the wastewater will depend on the source of pollutants and the water flows and volumes encountered. In general, the predominant contaminants are particulates, such as sand, grit, and other deposition on the road surface. Wastewaters of less concern are those generated infrequently by firefighting operations. Drainage from firefighting operations will carry contaminants only if there is an oil or gasoline spill coincident with the fire.

The primary concern is the tunnel washdown effluent which is generated on a regular basis as a result of routine maintenance. Normal tunnel washing operations consist of a high-pressure water flush once per month, and a thorough brush washing with detergent, three to four times annually. Biodegradable detergents compatible with oil and grease separation will be used for tunnel washdown. Tunnel washing adds pollutant loadings of chemical parameters found in highway runoff to the detergents which comprise tunnel drainage flow.

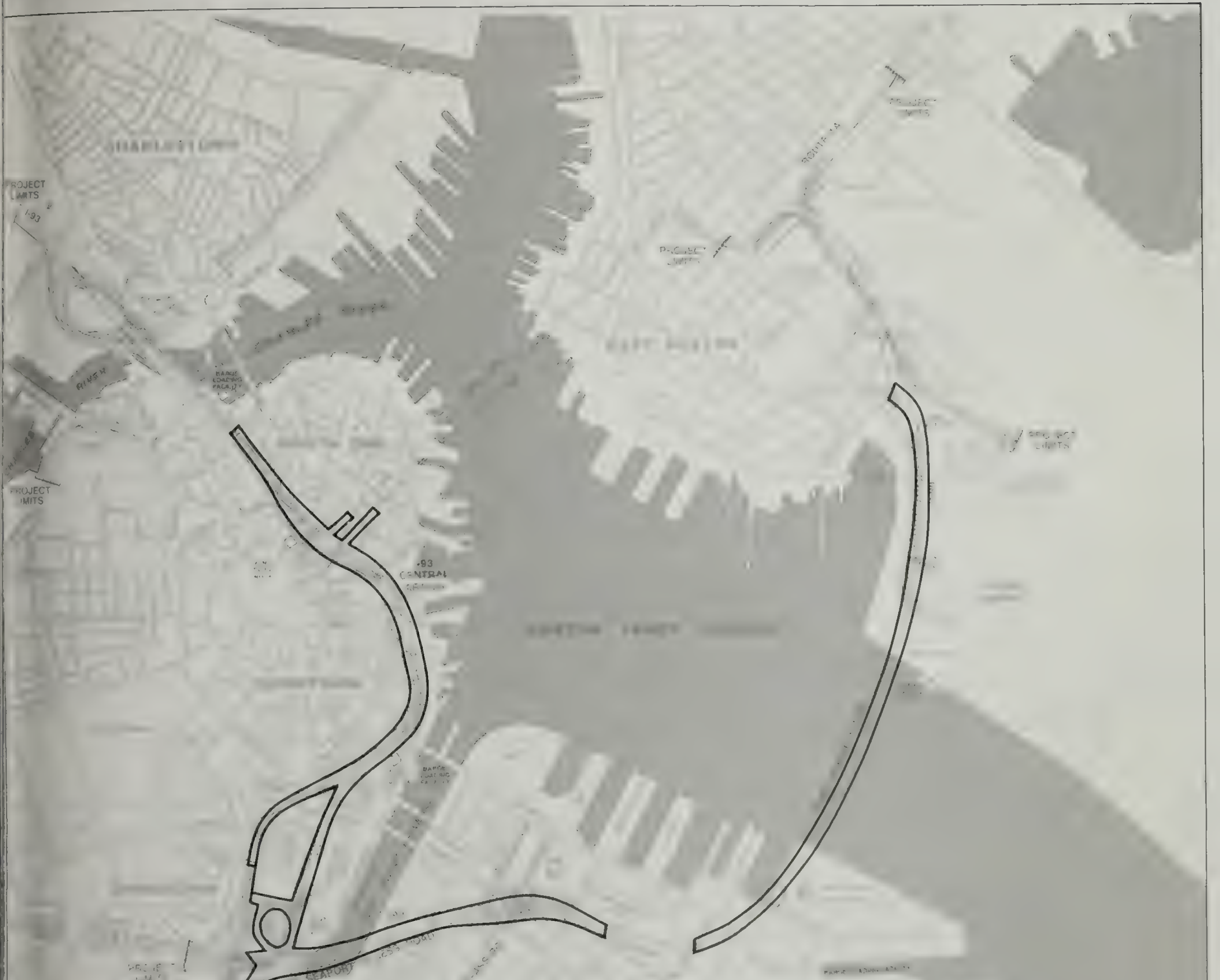
The projected quality of the washdown effluents depend widely on the average daily traffic and the frequency of the washing operations. The characterization of the washdown effluent quality will be performed during the conceptual and preliminary design of the pretreatment units that will serve the tunnels. Further treatment will be provided if required by the MWRA for the washdown water and for effluent to be discharged into the existing sanitary sewer system.

The basic components of the tunnel drainage system can be described as follows: Wastewater will receive pretreatment (sedimentation and oil/water separation) in the tunnel drainage system prior to discharge to an existing or new sanitary sewer in the vicinity. Overflow lines will carry the drainage water from settling basins into the inlet of the oil/water separator. The overflow water will contain oily waste, floatables which can pass through the bar screen, and any accumulation of oil or gasoline. Coarse solids will have settled out in the settling basins.

The effluent from the separators will not contain more than 10 ppm oil. Collected oil, sludge, and sediment will be pumped out to an oil collection tank sized to accommodate the types of oil spills which could occur, including contingency considerations. Since hazardous cargoes will be prohibited in the tunnels, major spills of fuel oil or other contaminants are not expected. The largest oil spills to be considered are in the order of 50 gallons and relate to the capacity of vehicle gas tanks which could be involved in accidents. When full, the oil collection tanks will be pumped by a licensed waste hauler, and the contents will be disposed of in accordance with the applicable State and local regulations.

The effluent from the oil/water separator will be discharged into a combined sump and pump chamber. The sump will provide additional storage capacity during peak flows and will provide a chamber of sufficient size to prevent rapid cycling of the sump pumps. The pumps will discharge to a manhole of an existing or new sanitary sewer main in the vicinity of the pump station. Additional studies will be performed to determine whether the BWSC and MWRA will accept the tunnel effluent without additional pretreatment, and what further pretreatment is required, if proposed treatment alone is not accepted by these agencies. The wastewater will need to meet the standards of these agencies before discharge to the sewer. Hydraulic capacity of the sewers will be investigated as a part of the detailed design process, but the projected wastewater flows are small enough so that problems of hydraulic capacity are not expected. With the wastewater receiving primary and secondary treatment at a wastewater treatment plant, impacts from residual contaminants are expected to be negligible.

Sewage. The second broad category of project effluent is sewage. Sewage will be generated at the project administration building in South Boston and the toll plaza facilities in East Boston. Other sites of sewage generation include ventilation buildings,



FIGURE

13.20 **Location Of Tunnel Sections**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

maintenance areas, and other staffed facilities. The quantity to be generated at the administration building is estimated at 7,300 gpd, which is directly related to the estimated number of employees who will work at the site.

Sewage will be discharged to the sanitary sewer serving the vicinity of the administration building. It will receive primary and secondary treatment at the MWRA Deer Island sewage treatment plants prior to discharge to surface waters. By the time the project will be operational, the Deer Island upgrade to a 1.1 billion gallon per day secondary plant will be completed. The impact from the project's sewage will be negligible.

13.2.4(b) Groundwater

Groundwater Levels. The depressed sections of the project could represent a potential barrier to the flow of groundwater. However, the groundwater level throughout the project is quite uniform and generally less than 10 feet below the ground surface. Such conditions indicate there is no significant groundwater flow in the project area.

Many measures will be used to provide that the existing groundwater regime is not affected by the project. In terms of engineering solutions, the following measures will be taken:

- Land tunnel designs will be developed with the minimum impact possible.
- Designs will be employed that will minimize the impact of groundwater.
- The tops of slurry walls put in place during construction between the top of the tunnel box and the land surface will be removed to maintain paths for natural flow over the top of the tunnel after construction.

The particular technology to be used at a given location will depend on site-specific considerations. These technologies will be carefully used to avoid further intrusion of the saltwater interface, and thus to avoid deterioration of groundwater quality. In addition, there will be an extensive groundwater level monitoring program that will provide early warning of potential problems so that additional measures can be taken if necessary.

Groundwater Quality. There will be no impact on groundwater quality as a result of facility operation. The roadway drainage system will be designed to prevent introduction of contaminants to groundwater. The structure itself will not release contaminants to the groundwater. No groundwater withdrawals or uses will be required by facility operations.

Based on the groundwater studies performed for the South Boston Haul Road, and addressed in the Final SEIS/R for that project, the alignment on which the South Boston Bypass Road will be built as part of the Artery/Tunnel Project will be served in part by an underdrain system which ultimately discharges to Fort Point Channel. The groundwater collected by underdrains from this area is of a quality suitable for discharge to Fort Point Channel without treatment. Therefore continued withdrawal of groundwater at the South Boston Bypass Road will not affect water quality of Fort Point Channel.

13.2.4(c) Industrial Water Use

Industrial and commercial users of surface waters in the project area are described in Section 13.1.4. Of the 12 identified users, only the Gillette Company's water intake system at its present location could be affected in the postconstruction phase. These impacts could arise from the reduction in the volume of Fort Point Channel upstream of the tunnel box near the existing intake, and the restraint to full tidal mixing by the proposed tunnel box. Mitigation will be provided in the form of relocating the Gillette cooling water intake. A new intake with equivalent hydraulic capacity will be provided downstream of the proposed tunnel. The existing intake will be abandoned. The existing cooling water discharge outfall will be retained. Thus, the new intake will be below the proposed tunnel box, and the discharge will be above the proposed tunnel box. After the relocation, there will be less interference of thermal discharge effluents with intake waters than occurs at present.

13.2.4(d) Stormwater Runoff

Project-related stormwater runoff will be generated on roadway surfaces and facilities exposed to precipitation. Stormwater runoff will be collected through inlets on at-grade highway sections, surface streets, medians, parking areas, and ramps. The inlets will lead to storm drains. Bridges and elevated highway sections will be provided with scuppers and downspouts that will discharge to drainpipes that lead to separate storm drains. Where a pumped discharge must be provided, the drains will lead to stormwater pumping stations. The storm flows will ultimately be discharged into the receiving water bodies. Runoff will not be generated, therefore, in the tunnel sections that make up a majority of the project structures, such as the Central Artery tunnel, but it will be generated on the surfaces above the tunnels, which include replacement surface roadway systems. Tunnel approaches will be designed to intercept runoff before it enters the tunnels to avoid flooding. These intercepted flows are also considered as part of the surface runoff to be generated by the project. Tunnel discharges will be collected and discharged separately from surface stormwater, as described in Section 13.2.4(a) above.

Presently, the storm runoff generated on the existing surfaces in the Artery/Tunnel Project area is directed into existing storm sewers, combined sewers, and CSOs being operated and managed by the Boston Water and Sewer Commission (BWSC) and the Massachusetts Water Resources Authority (MWRA). Under present conditions, storms frequently result in CSOs discharging pollutants into the receiving waters. These loadings include sewage-related pollutants, as well as traffic-related pollutants and other components of urban runoff, such as bacteria, BOD, solids, nitrogen, phosphorus, and metals.

As part of the comprehensive Federal, State, and local efforts to achieve water quality standards for Boston Harbor and its tributaries, the MWRA has begun a comprehensive study of CSOs in the Boston area. The purpose of this study is to evaluate the effectiveness of various preliminary engineering designs to reduce the pollutant loads from CSOs, thereby bringing area receiving waters into compliance with Federal and State water quality criteria and standards. One of the preliminary designs being evaluated is a plan to intercept CSOs of a certain volume by a system of drop shafts and tunnels, which would direct these flows to the expanded sewage treatment facility at Deer Island. The treated CSOs then would be discharged directly to the ocean through the MWRA's proposed Deer Island 9-mile-long outfall tunnel. Portions of surface storm flows generated on the urban street system thus would be treated if this system were in place.

However, the results of the study published in the Combined Sewer Overflow Draft Facilities Plan (MWRA, 1989, as referenced in the Bibliography to this SEIS/R), reveal that in addition to CSOs, Boston area stormwater contributes substantially to substandard water quality in the Boston area. The report concludes that, although the recommended CSO control strategies will result in improved water quality, even if all CSO discharges were eliminated, urban stormwater pollutant loadings would still be sufficient to cause water quality standards violations. This conclusion is consistent with findings in CSO facilities plans for other urban harbors, such as New Bedford Harbor, Lynn Harbor, and Nahant Bay. It would thus appear that the program to improve water quality in Boston Harbor should include an evaluation of and program for dealing with the stormwater runoff component of discharges to the Harbor.

In anticipation of the need to address and potentially treat a portion of the CSOs discharging to Boston Harbor, the BWSC and MWRA have been implementing a program of construction of separate storm sewers in areas served only by combined sewers. By connecting storm runoff presently discharging to combined sewers to the separate storm sewers, it was hoped that the volume of CSOs requiring treatment to meet water quality standards could be reduced. Based on the results of the MWRA CSO study discussed above, not only must the sewage component of CSOs be treated, but all of the storm runoff presently in CSOs, plus some portion of the stormwater discharged separately, requires some treatment. It is unclear how Federal, State, and local authorities are proposing to address these water quality issues concerning Boston Harbor and its tributaries. However, there are other potential water quality benefits to be achieved by providing separate storm sewers for the discharge of stormwater presently entering CSOs.

The volume of stormwater entering the CSOs greatly influences the frequency and duration of overflows from the system. Reducing the volume of stormwater discharged to the combined system will reduce the frequency and duration of overflows from the system, thereby allowing more sewage to reach the Deer Island treatment plant. A continued sewer separation program would also result in greater consistency between dry and wet weather flows reaching the Deer Island facility for treatment, in terms of both volume and characteristic pollutant loadings. By making these flows more consistent under all operating conditions, the facilities at Deer Island which treat the flows can be designed to accommodate and treat more typically average volumes and pollutant loadings, thereby providing more consistent, efficient, and economic treatment. As treatment processes become more efficient, the water quality benefits to Boston Harbor increase.

Proposed Project Drainage System. Because there are potential benefits associated with the continuation of the separation programs, the Department is proposing that the preliminary design of the Artery/Tunnel drainage system provide for the discharge of stormwater runoff to separate storm drains. For preliminary design of the drainage system, the roadway area, including surface city streets over tunnel sections, can be divided into 15 different drainage basins. This project area is currently serviced by 12 separate outfall systems, whereas 24 separate outfalls will be necessary for the proposed drainage systems as shown in Figure 13.10. These drainage areas, shown in Figure 13.14, have been delineated using plans and profiles for the proposed project and existing sewer maps. Available topographic maps have been used for unsewered areas and water divides.

For sewer drains which will collect and discharge surface runoff generated by the project, design assumptions have been established to reduce the impact of stormwater on the combined sewer system. These design assumptions include:

- Stormwater from the project will be discharged into existing separate BWSC storm drainage systems if sufficient system capacity is available.

- A proposed storm drain will not connect to an existing combined sewer.

- Where a connection to an existing separate storm sewer outfall is not feasible, or where no outfall exists, a new separate storm sewer outfall will be provided.

- A proposed storm drain will be designed for stormwater flow only. No sewage or other wastewater flow will be permitted to enter the proposed storm drain.

- Stormwater and tunnel water will be collected and discharged separately. Drainage of tunnel approaches will be designed so that stormwater will be intercepted prior to entering the tunnel drainage system.

The final design of the stormwater system to serve the project will be undertaken after further discussions between the Department and the MWRA, BWSC, EPA and DEP. In addition to the results of the MWRA CSO study noted above, Federal and State stormwater regulations are also being revised at this time, and may greatly affect both the design of the drainage system and the analysis of impacts of stormwater discharges required for permitting and water quality planning for Boston Harbor. The proposed EPA stormwater regulations, dated December 7, 1988, are intended to implement current provisions of the Federal Water Quality Act of 1987. These proposed regulations contain several options for regulating municipal separate storm sewers which would be applicable to the systems proposed for drainage from the project areas. These options contain the flexibility to address complex urban stormwater drainage systems on an areawide basis, especially where such an approach is warranted to address water quality issues.

In each of the 15 drainage areas shown in Figure 13.14, the project will alter the total roadway surface area exposed to precipitation, increasing surface roadway in some sections, and decreasing it in others, especially where existing surface roads are being placed in tunnel. As a result, stormwater flows will increase in some areas and decrease in other areas. Similarly, pollutant loadings in stormwater which result from deposition of vehicle exhausts will also be affected by the project's reconfiguration of surface roadways. This is especially true in the Central Artery area, where interstate traffic on the existing Surface Artery will be in tunnel and no longer contributing pollutants to the stormwater flows in this area. In addition, the imposition of more stringent automobile exhaust emission controls as a result of current as well as pending provisions of the Federal Clean Air Act affect the pollutant loadings in stormwater. By decreasing components, such as lead, in the exhaust, the contribution of such pollutants in stormwater runoff is decreased. All of these factors will affect the amount and characteristics of stormwater runoff, and render the use of predictive models to characterize stormwater difficult, even for present conditions, since most models (including EPA's NURP) are based on data collected in the early 1970s.

In the Boston area, all source discharges, including the CSO and separate stormwater discharges, must be addressed to achieve water quality standards for the Harbor. A comprehensive program will be required which involves all municipal separate storm sewer system operators, including the Department, BWSC, and MWRA. Stormwater drainage from the new Artery/Tunnel Project system is now, and would continue to be, predominantly tied into BWSC's main drainage system, though in some instances, separate discharges may be necessary. Since most of the project's stormwater will be tied into the regional BWSC system, its water quality impacts, and the potential need for stormwater controls and/or treatment, should be addressed during the permitting process for the rest of the BWSC system. Consistent with its obligations under the stormwater regulations, the Department is committed to be a full participant in this process in order to provide a comprehensive and workable program to achieve water quality standards. This process may include participation in the preparation of appropriate systemwide permit application, including monitoring programs to characterize the functions and impacts of the municipal separate stormwater systems serving the project area.

Major findings in this section are as follows:

- Placement of bridge piers in the Charles River will not affect the operation of the new Charles River dam pump station.

- Less encroachment of the Charles River through filling is proposed now than was the case in the FEIS/R. In addition, the decking of the proposed bridges is far above the 100-year flood level and therefore will not affect the water. Therefore, the water quality impact will be less than was the case in the FEIS/R.

- Under the 1985 FEIS/R plan, the Millers River would have been unaffected. The proposed placement of bridge piers in the Millers River, however, will not result in any incremental adverse effect on any of the water quality parameters of this already highly stressed water body.

13.3 MITIGATION MEASURES

Mitigation measures will be implemented to minimize impacts on all water bodies potentially affected. Major mitigation measures can be summarized as follows:

For Fort Point Channel:

- The relocation of the Gillette cooling water intake. Such a relocation will achieve continued performance of the cooling system.

- The removal of approximately 800 derelict piers, piles, and other structures in 4.5 acres of Fort Point Channel. The Channel near the Roxbury Canal Conduit is shallow, and the flow is constrained by debris and unused piles in many places. The removal of these abandoned structures in project work areas will improve water flow in the upper end of the Channel. In the long term, this action will also eliminate a persistent source of floating debris to Fort Point Channel and the Harbor.

For the Charles and Millers Rivers area:

- The removal to the mudline of all but one of the existing I-93 bridge piers. One pier (Pier A) will be demolished only to the water line so that the existing flow in the Charles River will not be affected. The remaining elements will be marked so that they will not be a hazard to navigation. The removal of these piers will improve flow conditions in the river and open up bottom habitat presently preempted by the structures.

For project stormwater:

- o The construction of the separated stormwater systems discharging to new outfalls, which will reduce combined sewer overflows and improve treatment at the Deer Island sewage treatment plant.
- o The impacts of stormwater on regional water quality must be addressed as part of a comprehensive Federal and State program to achieve water quality standards.

For project wastewater:

- o The need for pretreatment prior to discharge of tunnel effluent to sanitary sewer or CSO is being evaluated. Where there are no sanitary sewers or CSOs in the vicinity of the discharge point, new sewers will be provided. The tunnel drainage system will meet applicable effluent standards and will be operated so that the discharged effluent does not exceed 10 ppm of oil and grease, or other applicable parameters.

For groundwater resources:

- o The provision of engineering solutions (see Section 13.2) which will maintain existing groundwater levels, gradients, and flows.
- o The establishment of an extensive groundwater level monitoring program which will give early warning of unexpected short-term groundwater level fluctuations.

13.4 COMPARISON WITH FEIS/R

The most important change in the program since the FEIS/R is in Fort Point Channel. The proposed northbound Central Artery lanes have been removed from the Channel in the area north of the Dorchester Avenue bridge. In addition, the previously proposed total filling of the area south of the Dorchester Avenue bridge has been reduced. In the FEIS/R under the Preferred Alternative, approximately 20.8 acres in Fort Point Channel would have been filled. This has been changed to 8.4 acres under the Proposed Action and has resulted in a 60 percent reduction of encroachment to the marine resources of Fort Point Channel.

In Boston Harbor near the General Ship dry dock, there will be filling of approximately 3,145 square feet of harbor bottom, which had not been required in the FEIS/R. This amount of filling is negligible within the context of the volume and waterplane area of the Boston Inner Harbor. This filling seems the most prudent option at this time in order that the geometric alignment of the southern approach to the Third Harbor Tunnel can be accommodated.

The removal of the proposed Leverett Circle connector tunnel from the Charles River's south bank has also resulted in a 96 percent reduction of encroachment in the Lower Charles River and the near elimination of filling in the Charles River. The net change is negligible considering the gain on bottom area associated with removal of the existing bridge.

Approximately 3,000 square feet of the Millers River will be filled for bridge piers which were not required in the FEIS/R design scheme. This filling will not have any incremental effect on the flow of the Millers River, however, because the flow of this river already is constrained by the two culverts at its mouth. In addition, the Millers River is already highly degraded. The incremental impact on water quality indices, therefore, will be minor.

13.5 SUMMARY OF MAJOR FINDINGS

Major findings in this section are as follows:

- o Some hydrographic impacts to Fort Point Channel are expected because filling will reduce the volume of the water body by about 6 percent. Tidal flow will be constricted and water velocity will increase because of the tunnel box. The effects will be minor.

- o Stormwater flow generated on the proposed facilities will not cause a significant degradation of water quality.

- o Discharge volumes of surface runoff generated by the proposed highway will increase in some areas, when compared to the existing condition, and decrease in other areas. Therefore, the pollutant concentrations in outfall discharges will vary locally. They will increase at some outfalls and decrease at others. The cumulative discharge for the project will remain relatively unchanged. However, sewage overflow discharge into the Harbor will decrease due to removal of project stormwater from the CSOs.

- o Tunnel washdown water will be discharged to sanitary sewers for treatment. If additional treatment will be required by the MWRA and BWSC prior to discharging such effluents into the sewer system, the additional treatment will be provided.

- o Sewage will be generated at a small number of locations, such as the administration building and toll plaza. Sewage will be discharged to combined or sanitary sewers for treatment. There will be no impact on water resources from the generation of sanitary wastewater.

- o The project will have no impact on groundwater quality after construction. (Construction phase impacts are discussed in Chapter 20.)

- o Mitigation measures will be provided to eliminate any impact of the project on existing groundwater levels and flow patterns.

- o After construction, existing industrial users of surface waters, such as the Gillette Company, will be able to continue using the water sources that they presently use.

- o The Proposed Action will have less impact on water quality parameters than the Preferred Alternative in the FEIS/R.

- Implementation of the project will not interfere with the activities of others to clean up Boston Harbor.

13.6 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

During the agency review process a number of water quality issues were raised by DEP, BWSC, MWRA, EPA, the City of Cambridge Conservation Commission, the Massachusetts Division of Marine Fisheries, and the USACE.

The most significant issue to these agencies concerned the discharge of project stormwater. Based on recommendations of these agencies, the project is proceeding with a separate stormwater system design. This issue of stormwater management will continue to be evaluated in the context of the regional water quality planning now underway by DEP, EPA, MWRA, and BWSC.

Chapter 14 – Wetlands and Waterways

Chapter 14

WETLANDS AND WATERWAYS

The Proposed Action has the potential to affect wetland resource areas, filled and flowed tidelands, and the State's coastal zone. The purposes of this chapter are to:

- o Identify the locations and extent of the potentially affected waterways and wetlands within the project area
- o Describe impacts to each of these resources
- o Propose mitigation measures

Section 14.1 identifies and describes the potentially affected water bodies, namely, the Lower Charles River including, the Millers River, Fort Point Channel, and Boston Inner Harbor. The Outer Harbor will be affected only by the Proposed Action's Materials Disposal Program. Because the disposal program will have both short- and long-term impacts on Spectacle Island in the Outer Harbor, these impacts are discussed elsewhere in the SEIS/R. (For information about construction impacts on all wetlands and waterways affected, see Chapter 20. For more information on the Materials Disposal Program and its impacts on Spectacle Island, see Chapter IIB 4 of the SEIS/R.)

In this section, the functional values of waterways resources (such as navigational and industrial uses) and the wetlands and water resources (e.g., biological characteristics such as aquatic uses by fish and wildlife), are described for each water body. Section 14.2 describes and evaluates the impacts that the project could potentially have on waterways, wetlands, and water resources. The impacts are evaluated according to the functions they perform and their relative importance. The mitigation measures proposed in Section 14.3 are designed to reclaim the functions and values of wetlands that may be lost as a result of project activities and to maintain the public interests in waterways.

These resource areas are regulated by both Federal and State agencies. Since this document is being prepared to comply with the National Environmental Policy Act (NEPA), it provides information required by regulations in 40 CFR 1500-1508. In addition, this document contains information required by the following Federal and State regulatory programs:

- o the U.S. Army Corps of Engineers (USACE)
    - Section 10 of the Rivers and Harbors Act
    - Section 103 of the Marine Protection Research and Sanctuaries Act
    - Section 404 of the Clean Waters Act
- o Federal Executive Orders 11990 and 11988
- o the Massachusetts Wetlands Protection Act (MA WPA)
- o the Massachusetts Water Quality Certificate
- o the Massachusetts Waterways License Program (Chapter 91)
- o the Massachusetts Coastal Zone Management Program (MCZM)

Since the Massachusetts Waterways License Program (Chapter 91) is the only permit program among those listed above that has been changed substantially since the 1985 FEIS/R, the program's goals and objectives are summarized here. The Massachusetts Legislature amended Chapter 91 in 1983 and 1986, and the revised regulations based on these revisions are due to be promulgated in mid-1990.

The Waterways License Program under Chapter 91 is administered by the Massachusetts Department of Environmental Protection (DEP) to preserve the rights of the public in tidelands by ensuring that they are utilized only for water-dependent purposes or otherwise serve a proper public purpose. There are two kinds of tidelands regulated by DEP in the area included in the Proposed Action:

- Private tidelands are those areas between the natural high and low water lines, which can be privately owned, but on which the Commonwealth reserves and protects the public rights of fishing, fowling, and navigating.

- Commonwealth tidelands are all the lands below the natural low water mark, extending outward to the limit of State jurisdiction (3 miles), which are owned by the Commonwealth or held by private persons in accordance with the trust for the benefit of the public.

Chapter 91 applies to filled as well as flowed tidelands, so that any filled areas, formerly below the high water line, can be subject to its jurisdiction. At present, DEP focuses on impacts to filled tidelands within 200 feet of the water's edge or the first public way, whichever is more landward. The one exception is in areas selected by the Commonwealth as Designated Port Areas, where Chapter 91 covers all filled tidelands.

The basic goals of the Waterways Licensing Program are to:

- Protect and promote tidelands as a workplace for commercial fishing, shipping, passenger transportation, boatbuilding and repair, marinas, and other water-dependent activities for which proximity to the water is either essential or highly advantageous.

- Preserve pedestrian access along the water's edge for fishing, fowling, and navigation, and, in return for permission to develop nonwater-dependent projects on Commonwealth tidelands, provide facilities to enhance public use and enjoyment of the water.

- Protect sensitive natural areas from unnecessary encroachment by fill and structures.

- Encourage the development of municipal harbor plans to dovetail waterfront land use interests with the Commonwealth's concerns.

Projects licensed under Chapter 91 must fulfill a proper public purpose, have benefits that exceed detriments, and be consistent with State Coastal Zone Management policies. For the Proposed Action, this means that many types of impacts must be considered and balanced against the goals. Therefore, the discussion of the environmental consequences of the Proposed Action on flowed and filled tidelands makes reference to the chapters of this report addressing Land Use and Neighborhood Characteristics (Chapter 8), Visual Characteristics (Chapter 9), Water Quality (Chapter 13), and Part III, Section 4(f) Evaluation as it addresses parkland and open space systems.

14.1 AFFECTED ENVIRONMENT

Based on field investigations along the Artery/Tunnel Project alignment, resource areas regulated by the relevant Federal and State programs occur within or adjacent to the three water bodies mentioned above. Provided below is a description of each water body, its principal features and uses, its biological characteristics, identification of any special aquatic sites, and a review of its functions and values. (Figure 14.1 shows the location of wetland and waterway resource areas affected by the Proposed Action.)

While existing waterways and wetlands conditions in the project area have not changed much since the FEIS/R, the project alignment has been modified and now affects the Millers River but excludes part of Fort Point Channel. Applying the USACE definition of wetlands (Federal Manual for Identifying and Delineating Jurisdictional Wetlands, January 10, 1989), a narrow bank of bordering vegetated wetlands adjacent to the Millers River, and a narrow 10-foot strip of bordering vegetated wetlands on the west bank of Upper Fort Point Channel are additional wetlands which fall within the jurisdiction of the Federal regulatory authority. Areas subject to jurisdiction under State regulations include all flowed waterways and filled tidelands, in addition to the above areas of Federal jurisdiction.

14.1.1 Lower Charles River And Millers River

14.1.1(a) Area Description

Lower Charles River. The Lower Charles River (see Figure 14.2) lies between the old Charles River dam (constructed in 1910) at the Boston Museum of Science and the new Charles River dam (constructed in 1976), which is also known as the Colonel Gridley Locks. Following construction of the new dam and locks, tidal fluctuations within the Lower Charles River were effectively eliminated. The locks are used to permit vessels to move between the Charles River and the Inner Harbor.

The Lower Charles River is approximately 2,200 feet long. Its width varies but averages 450 feet. The width on the west side of the new dam is approximately 600 feet, narrowing to about 375 feet beneath the MBTA commuter railroad bridge, and increasing to approximately 450 feet west of the railroad bridge. The greatest width (1,200 feet) occurs immediately east of the old dam. Average water depth is approximately 17 feet, with a maximum depth of 24 feet at a location between the railroad bridge and the new dam.

Fresh water from the Charles River drainage basin flows continuously through the spillways and locks of both the old and new dams before entering the tidally influenced Boston Inner Harbor. The mean annual flow from the river is approximately 450 cubic feet per second (cfs), and the 7-day, 10-year low flow is approximately 22 cfs. The effect of the new dam is to maintain constant water depth in the river, given the varying flow. The mean annual flood capacity is 1,900 cfs.

The new Charles River dam is a part of the flood protection system for the low-lying areas of the Boston region. During storm high tide, the water elevation of the Harbor can be higher than that of the Charles River Basin on the other side of the dam. In order to maintain the proper water elevations within the basin -- subject to the possibility of excess inflow from either direction -- a pumping station was built, which includes six 1,400-cfs-capacity pumps. The pump station controls are set to maintain an elevation of

2.35 feet above mean sea level. The reported 100-year flood elevation is 4 feet above mean sea level. Currents and circulation in the basin are determined entirely by the release rate from the Charles River dam. Currents are most likely unidirectional toward the dam and their velocity will depend on the location. At the narrowest point beneath the railroad trestle, velocity could average 1 foot per second, and velocity could be higher than 5 feet per second under flood conditions.

The piers of the Charles River bridge (part of the existing Central Artery) cross the flow path of the river just upstream of the pumping station. Still further upstream, the Boston and Maine Railroad bridge (MBTA commuter railroad trestle) crosses the river, creating a left and right overbank due to the dense pilings underneath (see Figure 14.3). The downstream flow between the overbanks results in a "jet" (concentration) of relatively high velocity flow, curved towards the north shore. This high velocity jet approaches Pier A of the Charles River bridge (see Figure 14.3), causing a large separation region downtream of the pier. The uneven rate of flow of the water, together with secondary eddy currents, would be carried into the pumps, causing low frequency vibration, imbalance, and fatigue. Pier A, however, is hydrodynamically streamlined in order to achieve a uniform flow rate into the pump station (see Figure 14.4).

Millers River. The Millers River is a short (approximately 1,000 feet long) and shallow waterway on the north side of the Lower Charles River near the new Charles River dam. It is separated from the Lower Charles River by an earth dam and drains into the Charles River through two 84-inch culverts. Drainage into the open portion of the Millers River at its upstream terminus is through three 48-inch storm sewers from a densely developed urban and industrial area, which includes adjacent railroad yards. Although the Millers River originally extended beyond the current limits and was tidal, historic filling and construction of the new Charles River dam have altered the water course to its present size and type, and have converted it into a freshwater system. The Millers River has a drainage area of approximately 1,000 acres and a surface water area of 1.7 acres. The water depth was determined with a recording fathometer and the plots indicate a uniform maximum depth of 3 feet. The volume of the Millers River is, therefore, approximately 222,000 cubic feet.

The mean annual flow of the Millers River is 3 cfs while the mean annual flood is 55 cfs. The 7-day, 10-year low flow was determined to be less than 0.1 cfs. Based on existing information, it can be concluded that the local hydrology is driven primarily by surface waters. There is no evidence of groundwater input such as seeps or springs. Stormwater runoff is considered to be the main hydrologic contribution to the Millers River as well as the prominent factor in circulation, flushing, and dilution. Based on the volume and flow rates, the river has a mean daily flushing rate of 1.2, and during the 7-day, 10-year low flow the river shows no flushing activity.

Currents and circulation in the Millers River are determined by wind blowing along the axis of the river and water flow from the river to the Charles River. Given the small grain size of the sediment particles (90 percent of the particles are in the silt/clay range) in the surface muds and the depth of the sediments, the environment is strictly depositional and flows do not appear to exhibit any erosive potential.

Water level fluctuations are determined by the elevation of the Charles River. Water flowing from the Millers to the Charles River passes through two 84-inch culverts.

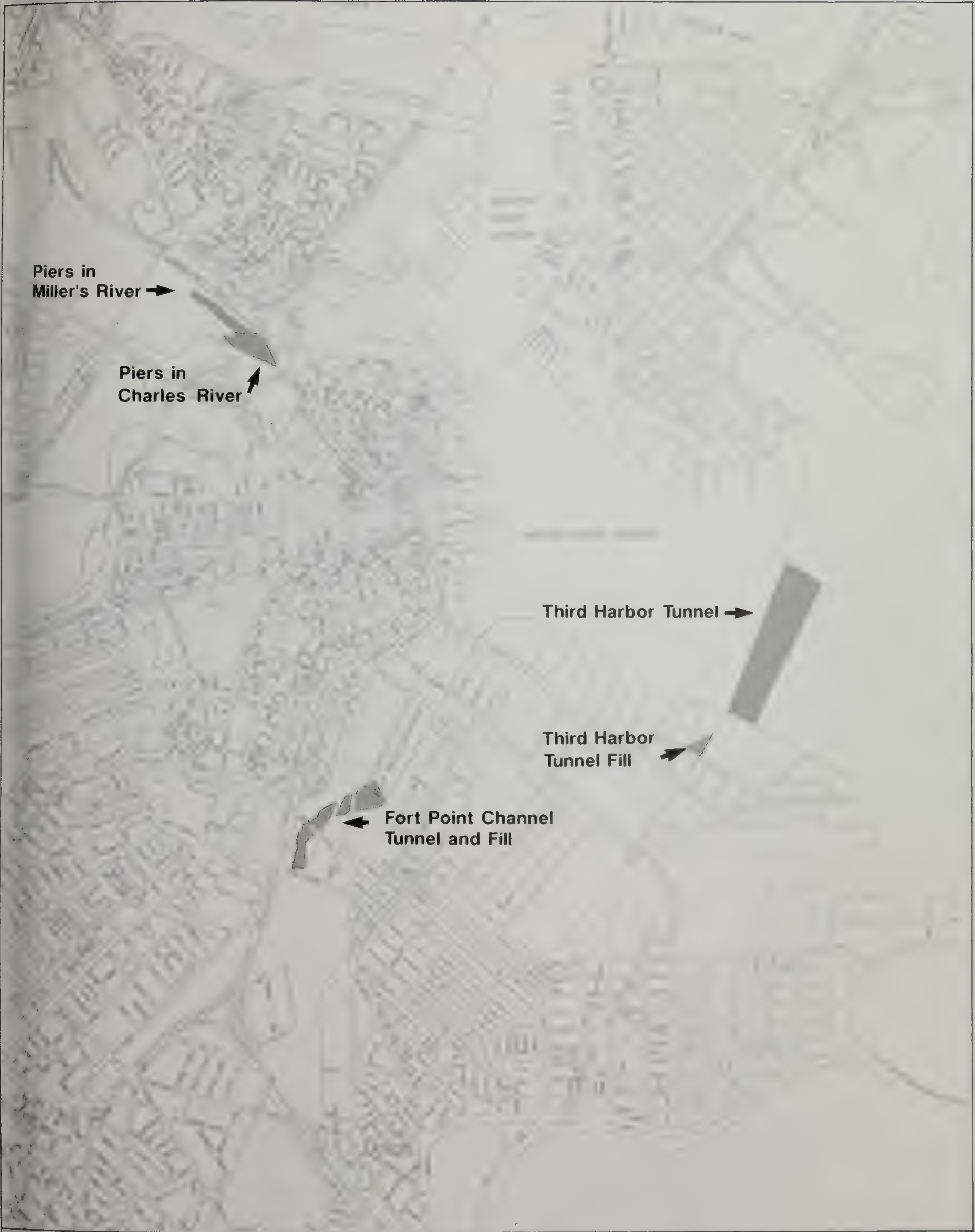
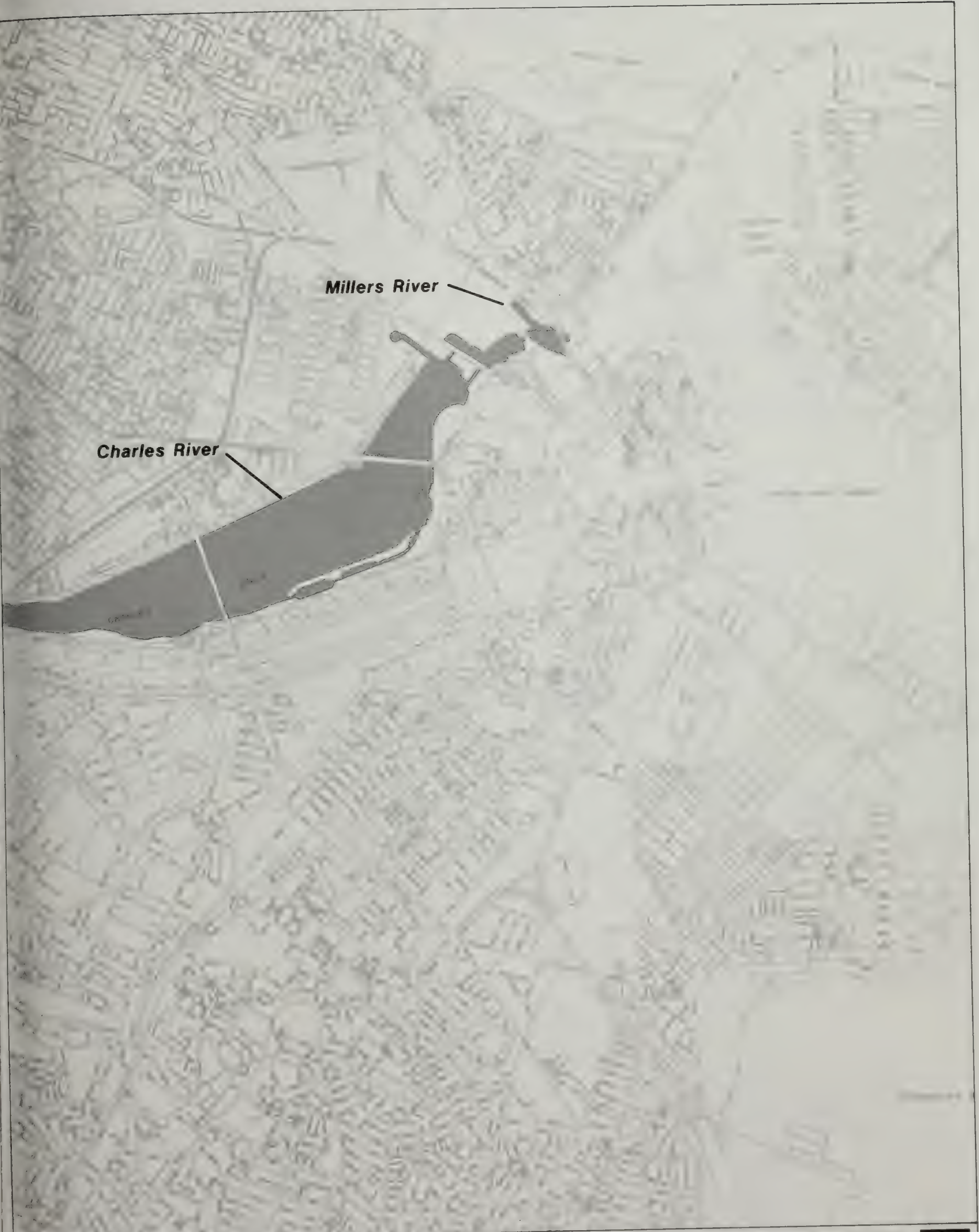


FIGURE 14.1

Locations Of Activities In The Water

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet



FIGURE

14.2 Location Of Charles And Millers Rivers

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

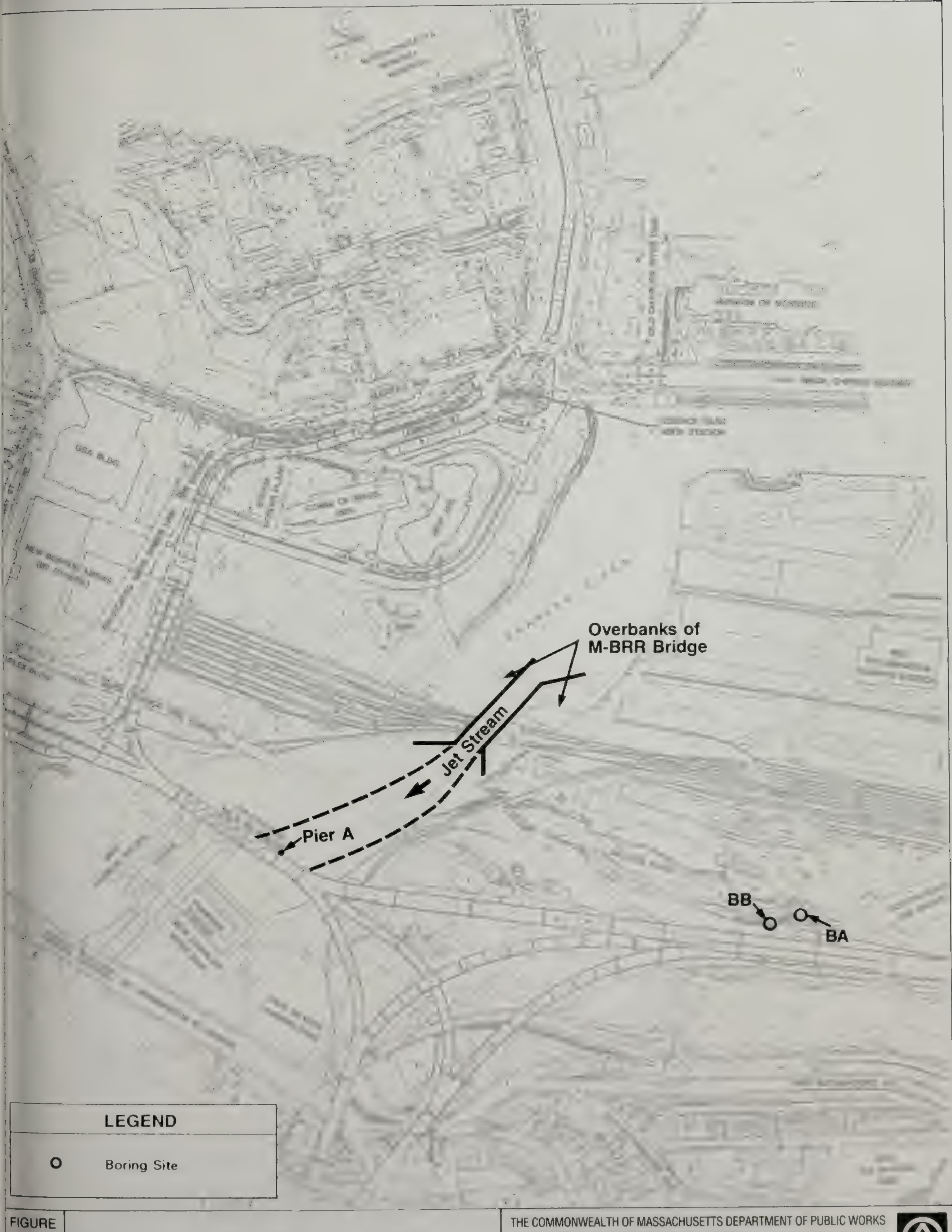
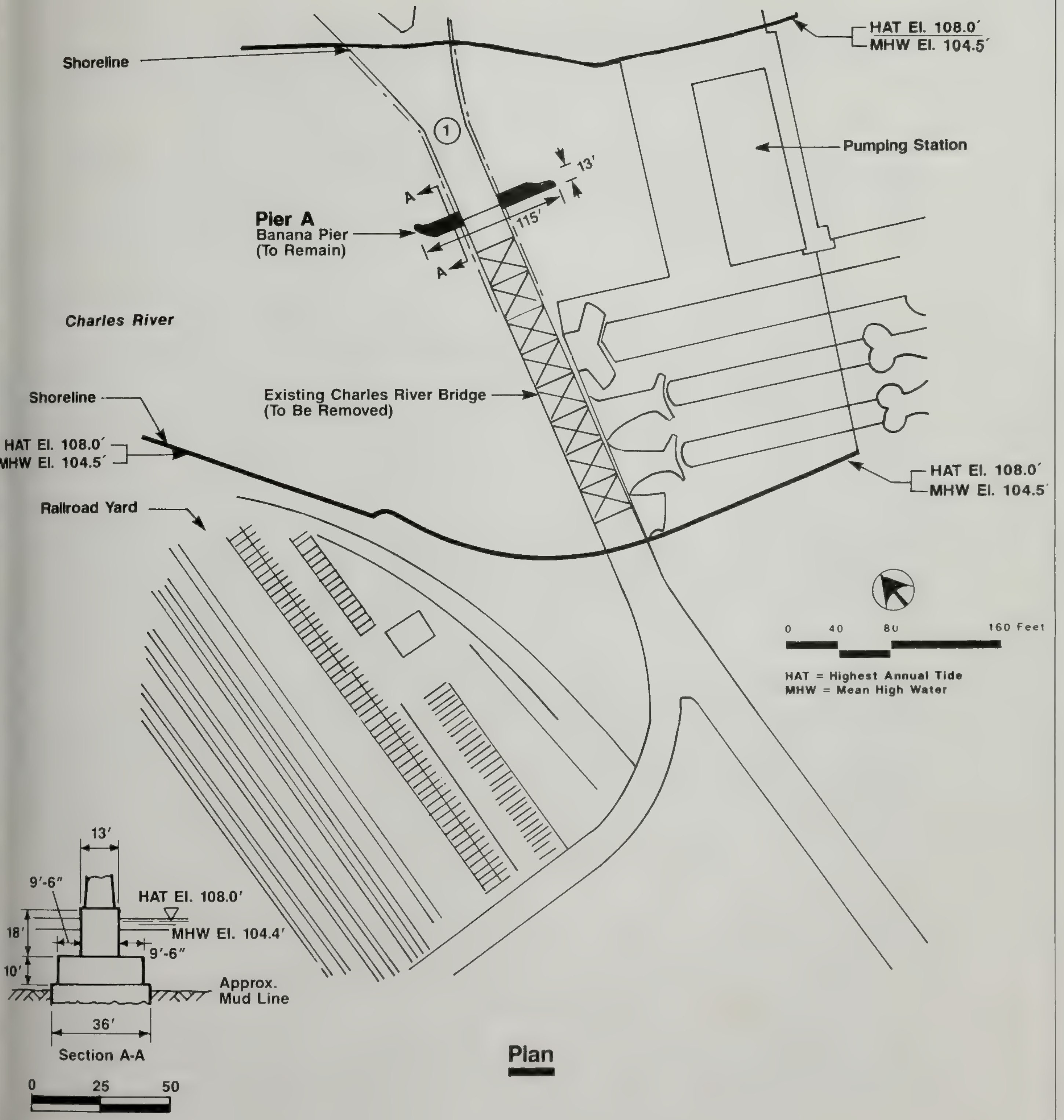


FIGURE
14.3

Water Quality Features In The Charles And Millers Rivers

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



FIGURE

14.4

Pier A - Charles River Bridge

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

The culverts are located approximately 900 feet upstream of the Charles River dam and flood control pumping station. Controls in the pump station are set such that pumping starts when water reaches the elevation of 2.35 feet above mean sea level. The 100-year flood elevation is reported to be 4 feet above mean sea level.

There is no evidence or information that the Millers River has an appreciable interaction with groundwater. The drainage basin is a heavily developed urban and industrial area which severely limits recharge. Without appreciable recharge, the amount of groundwater discharge is limited. The till and clay which underly the recent river deposits also serve to limit groundwater interaction.

14.1.1(b) Wetlands Resources

Field studies have indicated the presence of nontidal waters and inland wetlands in the Charles River. The boundaries of inland wetlands adjacent to the Charles River were marked and surveyed in accordance with the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (Reference 7) and using the required New England Division (NED) USACE forms. This boundary is being reviewed by NED/USACE. A total 2,175 square feet (0.05 acre) of inland wetlands were found along the perimeter of the river. The inland wetlands occur along the Charles River riprap.

Scrub/shrub, as well as emergent wetland vegetation, is present. Typical species include indigobush, cottonwood, reed grass, seaside goldenrod, strawcolor nutsedge, and wild millet. On the upland side, typical species include staghorn sumac, multiflora rose, wormwood, Canada bluegrass, rough bentgrass, and downy chess. Several of the upland areas are largely unvegetated.

The surface sediments of the Lower Charles River and Millers River contain heavy metals and organic chemicals (see Tables 13.9 and 13.10 in Chapter 13). The benthic community contains only pollutant-tolerant worms. The substrate in the Charles River consists predominantly of organic mud and silts, with lesser amounts of sand and clay. During 1988, sediment samples were collected from the Charles River at locations where bridge piers would be constructed. These samples were tested for bulk chemical quality and extraction procedure (EP) toxicity. The results of the analyses are provided in detail in the Soil and Groundwater Quality Report (Report 6), a technical report prepared for this SEIS/R.

The surface sediments have been found to be highly contaminated with metals. The most notable elements are cadmium, chromium, copper, lead, mercury, and zinc. Surface sediments also contain high concentrations of petroleum hydrocarbons and PCBs. PCBs were found to be present at concentrations less than 50 mg/kg, indicating that they are not within the hazardous category. A clear and rapid improvement in sediment quality was noted with increasing sediment depth, although mercury was still found at high levels deep into the sediment. The results of the EP (extraction procedure) toxicity tests indicate the sediment leachate was well within (10 to 100 times lower than) the maximum EPA contaminant level, and thus the material would not be classified as a hazardous waste.

The Charles River contains moderate suspended solids with a range of 6.8 to 7.2 mg/l. Turbidity levels range from 1.0 to 1.5 nephelometer turbidity units (NTU). Although the suspended solids concentrations are at a moderate range, water color has been found to be the main determining factor in water clarity. The Charles River has high color values, and the water is noticeably amber to dark brown.

The Charles River supports a warmwater fishery which is present upstream of the new Charles River dam. During July 1981, the Massachusetts Division of Fisheries and Wildlife conducted a fishery survey near the Boston University Bridge further upstream. In order of abundance, the fish found in the sampling included golden shiners, white perch, alewife, pumpkinseed, yellow perch, white sucker, white catfish, northern pike, chain pickerel, and brown bulkhead. Growth rates were reported to be excellent, and the condition factor was comparable to Statewide average. Some of these species are likely to be found also between the old and new dams.

The Charles River also contains an anadromous fish (seasonal migrating ocean fish that spawn in fresh water) run. These fish which pass into the Charles River via a fish ladder in the dam include smelt, herring, and alewives. The Charles River also contains one of the largest alewife and river herring runs in the Commonwealth.

The banks of the Charles River in the vicinity of the project consist of manmade stone revetments and bulkheads. They are sparsely vegetated with successional weed species. The banks are subject to flooding. Approximately 2,175 square feet of vegetated wetlands are present on the riprapped banks near the Millers River outlet. This area is dominated by indigobush (*Amorpha fruticosa*).

During November 1989, the Millers River was sampled for fish using electroshocking techniques. Approximately one-third of the river was electrofished, including the end closer to the Charles River where dissolved oxygen levels may have been suitable for fish. Results from fish sampling in the Millers River indicate an absence of fish, without any sign of such presence.

Sediment samplings have indicated that the levels of dissolved oxygen are too low (0.8 to 8.8 mg/l) to support fish or other aquatic life in the Millers River. The sediments sampled were heavily contaminated with petroleum derivatives. Sampling for benthic macroinvertebrates was conducted during November 1989. One sludge worm (*Tubifex tubifex*) was found, indicating no diversity or abundance in the invertebrate community. Based on this information and the results of the bulk chemical sediment analyses, it can be concluded that the sediments are too contaminated to support a diverse invertebrate community. [More details can be found in the 404(b)(1) Guidelines Appendix.]

Field investigations have revealed also that there are no shellfish in the Millers River.

The banks of the Millers River are steep, and consist of mud and silt, rubble, and stone riprap. They are mostly vegetated with successional weed species; although disturbed, unvegetated areas are present as well. Unstabilized portions of the banks, particularly adjacent to the Boston Sand & Gravel Company property, are causing sedimentation of the river. In addition, cement trucks hosed down in an area immediately adjacent to the north end of the river, draining into the river, degrades water quality. As noted above, the Millers River abuts Boston Sand & Gravel and I-93. Accordingly, adjacent lands are highly disturbed and public access to the area is limited. The river bottom consists of more than 10 feet of organic oily muds, indicating a depositional environment.

Field studies have indicated the presence of nontidal waters and inland wetlands in the Millers River. The boundaries of inland wetlands adjacent to Millers River were flagged and surveyed in accordance with the Federal Manual for Identifying and Delineating Federal Jurisidictional Wetlands and using the required NED/USACE forms. This boundary will be reviewed by NEDUSACE. A total of 19,165 square feet (0.44 acre) of inland wetlands were found along the perimeter of the river. The narrow wetland border (1 to 5 feet) is dominated by reed grass, which is typical of disturbed situations. Plant diversity and interspersion are low. The uplands immediately surrounding the wetlands are generally unvegetated. A list of plant species observed in the Millers River is provided in Table 3.6 in the 404(b)(1) Guidelines Appendix. Activities associated with Boston Sand & Gravel operations, construction of the Central Artery North Area (CANA) Project, and operation of I-93 overhead provide continual disturbances to the area.

Minimal wildlife was observed in the wetland area and is limited to a few songbird sightings. No signs of other birds, mammals, amphibians, or reptiles have been observed. Disturbance from adjacent land uses as well as poor water quality of the river itself severely limits wildlife habitat suitability. No food or fiber production occurs in this resource area. Additionally, the area does not meet any mineral needs.

Figures 14.5 and 14.6 show views of the affected areas of the Charles and Millers Rivers. Figure 14.7 shows the locations and extent of inland wetlands at both rivers (Federal delineation).

The functions that this resource area (i.e., both Charles and Millers Rivers together) could potentially perform are:

- flood control capacity
- storm damage control
- prevention of pollution
- protection of public and private water supplies
- protection of groundwater supply
- bordering vegetated wetlands
- fisheries habitat
- wildlife habitat
- recreational boating

Flood control and storm damage prevention functions are provided by the new Charles River dam located downstream. This dam controls the water elevation upstream in the project area. Therefore, there is little need in the project area for the banks to provide flood control and storm damage prevention functions.

Millers River provides some flood storage capacity, but this feature is rendered quite unimportant due to the close proximity of the Charles River dam which artificially controls flooding.

Prevention of pollution is not likely to be served by the banks of the Charles River. They consist of bulkheads and revetments formed of rock and, therefore, cannot effectively decrease pollution. The bordering vegetated wetlands along the Millers River may attenuate some pollutants and serve as a sediment filter. They also anchor the bank and prevent shoreline erosion by slowing down water speeds.

The resource areas along the Lower Charles and Millers Rivers are not of very high value. [See Sections 3.6.1 and 3.6.2 of the 404(b)(1) Guidelines Appendix.] Neither is, in fact, a source of drinking water, nor are they used for industrial purposes at the project location. They do not provide recharge or discharge of an aquifer used as a potable water supply.

A warmwater fishery and anadromous fish are present in the Charles River. The adjacent banks, however, provide only limited fisheries habitat since, among other factors, they have no overhanging vegetation which could shade the river. Similarly, for wildlife habitat, the channel of the river supplies fishing areas for diving birds such as cormorants, while the adjacent banks and land subject to flooding have limited value due to their disturbed and sparsely vegetated nature.

Since there are no fish, nor any sign of their presence, the Millers River is therefore not an important fisheries habitat. The amount of disturbance surrounding the Millers River and the poor water quality also substantially limit any wildlife value the reed grass stands could potentially offer.

Coastal resources associated with the Lower Charles River below the new Charles River dam are important for their flood storage capacity and the stability of their banks. The coastal banks consist of either stone riprap or piers and pilings. The 100-year floodplain is restricted to the banks. Fisheries resources are similar to those described below for Boston Inner Harbor. Wildlife diversity and abundance is limited by the uniformity of available river habitat, i.e., lack of adequate vegetation, embayments, or bank diversity. Wildlife habitat is restricted to perching areas provided by the banks, and feeding areas supplied by the river itself for diving birds like cormorants. No shellfish beds have been observed in the vicinity of the project in the coastal portion of the Lower Charles River. The resources, therefore, are not important for the protection of shellfish habitat.

[For more details on the specific functional assessment of the resources in the Charles and Millers Rivers, see Section 3.6 of the 404(b)(1) Guidelines Appendix.]

4.1.1(c) Waterways/Flowed Tidelands

The Charles River is officially navigable and has several marinas on its north shore. (Table 14.1 lists the navigational constraints in Fort Point Channel and the Charles River.) However, there are no marinas in the Lower Charles River between the two dams. There are also several piers in the Lower Charles River. (Table 14.2 lists the major existing piers and berths within the project vicinity.) A system of two dams separates the river from Boston Harbor. The inner, or old Charles River dam is located by the Museum of Science at the head of the Charles River Basin. It has one lock which is maintained in an open position and leads into the Lower Charles River. The outer, or new Charles River dam is located immediately east of the existing Central Artery high bridge. There are three locks located in the new dam, and all vessels navigating between the basin and Boston Harbor must pass through these locks. The largest lock can accommodate vessels of up to 300 by 40 feet. The controlling depth in the area between the two locks is 15 feet.

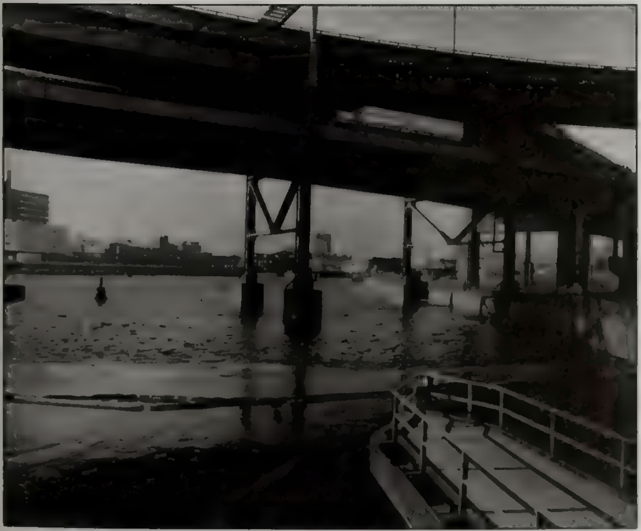
At present, there is relatively little commercial traffic navigating into and out of the Charles River. Commercial activity is limited to barges which are used for either fireworks displays or construction activities. The largest barges currently operating in the Charles

New Charles River Bridge will be on alignment in foreground.

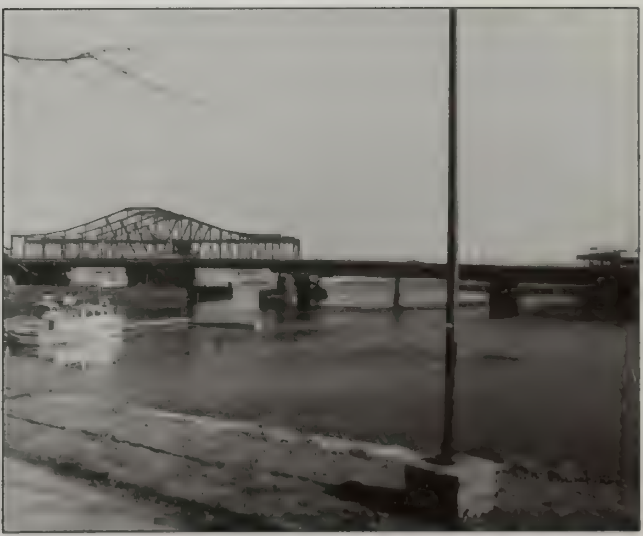
Close-up view of high level double-decked bridge to be removed.

Navigation channel markers at Charles River Dam locks.

Pedestrian walkway (left) over Charles River Dam locks.



View of high-level double deck bridge from Charles River Dam walkway.



Temporary barge loading site at edge of Paul Revere Landing Park. MDC Harbor Police boat and Charlestown Bridge in background.

FIGURE

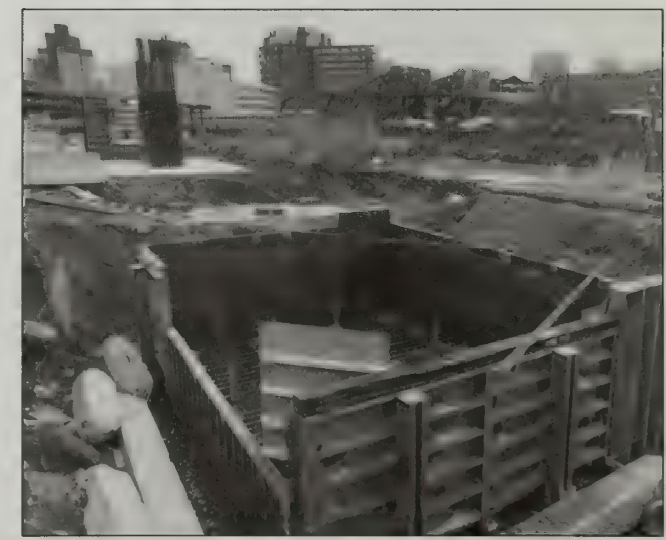
14.5 **Views Of Charles River**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

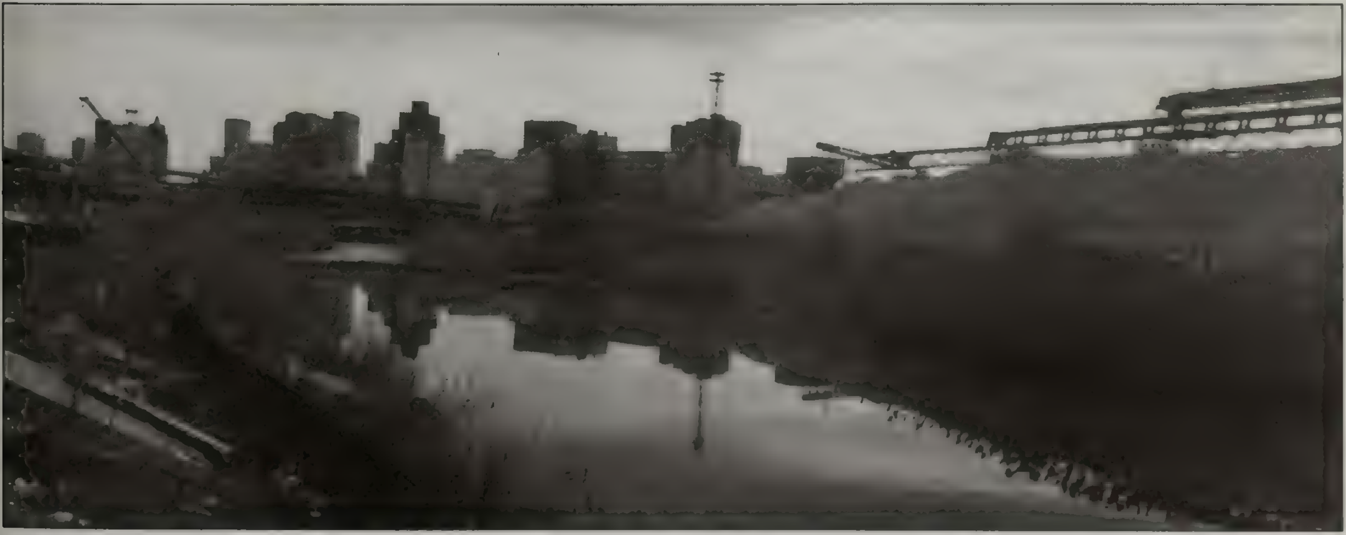
Two filters in Millers River screen solids from entering Charles River.

Boston Sand And Gravel and existing I-93 viaduct flank the north end of the Millers River.

Millers River drains into the Charles River at this point via two culverts under an earth dam.



Pier foundation under construction near Millers River for CANA project viaducts.



View of Millers River looking south.

FIGURE
14.6

Views Of Millers River

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

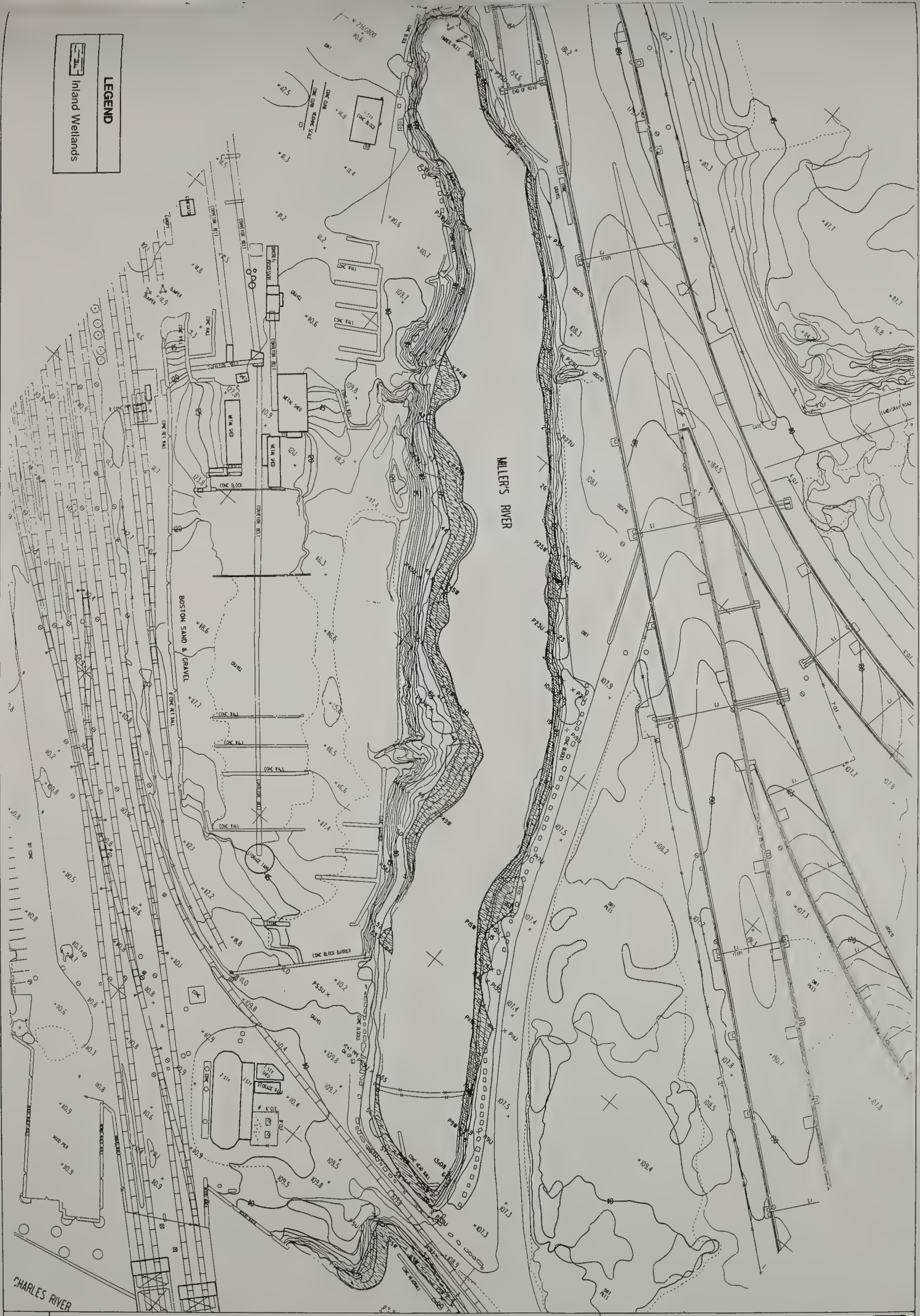


FIGURE 14.7 Millers And Charles Rivers Inland Wetlands

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 14.1

CONSTRAINTS TO NAVIGATION IN FORT POINT CHANNEL AND CHARLES RIVER

FORT POINT CHANNEL

Controlling Depths

Mouth to Northern Avenue bridge: 11 feet (1981)
Northern Avenue bridge to Summer Street bridge: 15 feet (1978)
Summer Street bridge to Dorchester Avenue bridge: 21 feet (1959)

Width And Airdraft Restrictions

Northern Avenue bridge: swing span with 7-foot vertical clearance; 75-foot horizontal clearance
Congress Street bridge: bascule span with 6-foot vertical clearance; 75-foot horizontal clearance (maintained closed)
Summer Street bridge: retractable span with 4-foot vertical clearance; 51-foot horizontal clearance (maintained closed)
Dorchester Avenue bridge: limit of navigation

CHARLES RIVER

Mouth to Charlestown bridge: maintained at 35-foot depth; "no wake" speed limit
Charles River dam: 3 locks, largest 300 feet long, 40 feet wide, 14 feet over the sill; overhead walkway with monorail has minimum airdraft clearance of 26 feet
Upper Charles River dam: single lock, length 350 feet, width 45 feet, 17 feet over the sill (maintained open, nonoperational)
Between the dams: controlling depth 15 feet
Charlestown bridge: fixed bridge, 23-foot vertical clearance; 50-foot horizontal clearance
I-93 bridge: fixed span with 48-foot vertical clearance
MBTA commuter railroad bascule span: 3-foot vertical clearance[1]

---

[1] This bridge also is referred to as the Boston and Maine Railroad Bridge

Source: United States Coast Pilot 1, NOAA

Table 14.2

MAJOR EXISTING PIERS AND BERTHS IN THE VICINITY OF PROJECT ACTIVITIES

Charles River

U.S. Coast Guard Piers 1, 2, and 3 and marginal wharf: mooring Coast Guard vessels
Massachusetts Port Authority Hoosac Pier No. 1: not used
Lovejoy Wharf: deteriorated, proposed ferry terminal location
MDC Harbor Patrol Dock: mooring patrol boats
Other miscellaneous piers proposed

Fort Point Channel - East Bank

Fan Yard Pier No. 1: mooring for excursion vessels
Neptune Lobster and Seafood Co. Wharf: receipt of seafood, mooring fishing boats
Transportation Museum Wharf: mooring vessels, including floating restaurants, exhibit vessels, and other miscellaneous vessels

Fort Point Channel - Mid-Channel

Mooring for exhibit vessels (1988: the "Beaver")

Inner Harbor - Western Shore

Rowes Wharf: ferry terminal and ferry mooring; includes marina basin
Long Wharf: mooring excursion and sport fishing boats

Inner Harbor - South Boston Shore

Subaru Pier (Massport Marine Terminal Wharf): presently used for car receival and storage
General Ship Piers 5 and 6: used to moor vessels for repair, conversion, and outfitting; abut Graving Dock No. 4
Dry Dock #3: presently inactive; previously used for battleship and aircraft carrier repair

Inner Harbor - East Boston Shore

Massport Fireboat Dock: mooring fireboat and police vessels, and ferry terminal

---

Source: The Port of Boston, Massachusetts, Port Series No. 3, U.S. Army Corps of Engineers are approximately 145 by 32 feet, and total barge lockings are estimated at 60 per year, or one every 6 days. (Commercial navigation is discussed further in a draft technical report prepared for this study, Maintenance of Barge Traffic Through the Charles River Lock and Dam, July 1988.)

There are considerable recreational navigation activities in the Charles River Basin, with the majority of recreation craft remaining within the basin proper at all times. However, larger recreational vessels do travel between the basin, through the Lower Charles River, and Boston Harbor. Such traffic between the two bodies is seasonal, with higher volumes during the summer months. The peak travel period is the Fourth of July weekend, when approximately 3,000 recreational vessels are locked through the new dam. During the Fourth of July weekend, boats can wait for up to 2 hours to pass through the locks. Boats queue by the Charlestown bridge while waiting to travel into the basin and below the North Station bascule bridge when travelling to the Harbor. Due to calm water conditions, boats generally do not drop anchor while waiting to pass through the locks, even in bad weather.

The waterway between the two dams is not used for water-based recreational activities except as a passageway for vessels navigating between the Charles River Basin and the Harbor. Water-based recreational activities generally occur either in the Charles River Basin or in the Harbor, and not in the Lower Charles. Currently, the waterway provides a focus for landside viewing at the Paul Revere Landing Park and at the recreational pier behind Spaulding Rehabilitation Hospital. However, under future park plans, facilities may be developed around the Lower Charles, and water-based recreational uses could be introduced in the area.

Directly below the new Charles River dam, where the mouth of the Charles River meets the Inner Harbor, is a navigable waterway area with a depth ranging from 20 to 35 feet. It is currently used primarily for recreational boating.

There are no commercial water transportation facilities in the lower Charles River Basin or in the mouth of the river south of the new Charles River dam.

14.1.1(d) Waterfront/Filled Tidelands

The filled tidelands around the Charles River Basin include both Commonwealth and private tidelands. Current land uses at the water's edge are primarily rail transportation, industrial, institutional (hospital), and open space uses. (See Chapter 8, Land Use and Neighborhood Characteristics, Section 8.1.1, Area North of Causeway Street, and Chapter 9, Visual Characteristics, Section 9.1.1, Area North of Causeway Street, for detailed description of area uses.) The following describes the affected environment in terms of Chapter 91 interests of public access, open space and on-shore facilities supporting water-based recreation, since no maritime industrial uses exist in the affected area.

North Station/Leverett Circle Area. A new regional transit station, commuter rail station, an underground parking garage, and the improvements to the MDC open space near the new Suffolk County Jail are the public projects planned for the North Station area. The MDC open space opposite the new Suffolk County Jail will be linked to a riverfront walkway and pier structure, to be developed by the Spaulding Rehabilitation Hospital as part of its Chapter 91 license condition for hospital expansion. There is currently no riverfront public access between the hospital and the new Charles River dam, due to the presence of the North Station railroad yard.

There are currently no active uses of the water's edge for boat landings or marinas above the dam in the area to be affected by the Proposed Action. The first active use of the shoreline for boating above the Longfellow bridge on the Boston side is the Community Boating facility. The only active water-dependent use below the Charles River dam is the MDC Harbor Patrol Dock. Below the North Washington Street bridge, the water's edge is reserved for public access as part of the Harborpark walkway system.

Cambridge. The North Point area of Cambridge is bounded by the Charles River on the south, O'Brien Highway on the west, Somerville to the northeast, and the Millers River and Charlestown to the southeast. This area includes primarily the nonwater-dependent uses of the MWRA Prison Point Pumping Station, an MDC maintenance facility, a Department storage area, railroad tracks and piggyback yards owned by Guilford Transportation Industries and a solid waste transfer station. Plans for the redevelopment of the area have been advanced by the Cambridge Community Development Department, and they include a mix of residential and commercial uses, with open space at the river's edge.

Most of the riverfront property in this area is privately owned, except for the MDC maintenance area, which the agency would like to develop as a park. There is no public access in this area at the present time.

Charlestown. The Paul Revere Landing Park is the primary riverfront use above the North Washington Street bridge. It is currently made less accessible by the CANA project, but will be improved by it, as outlined in that project's Chapter 91 license conditions.

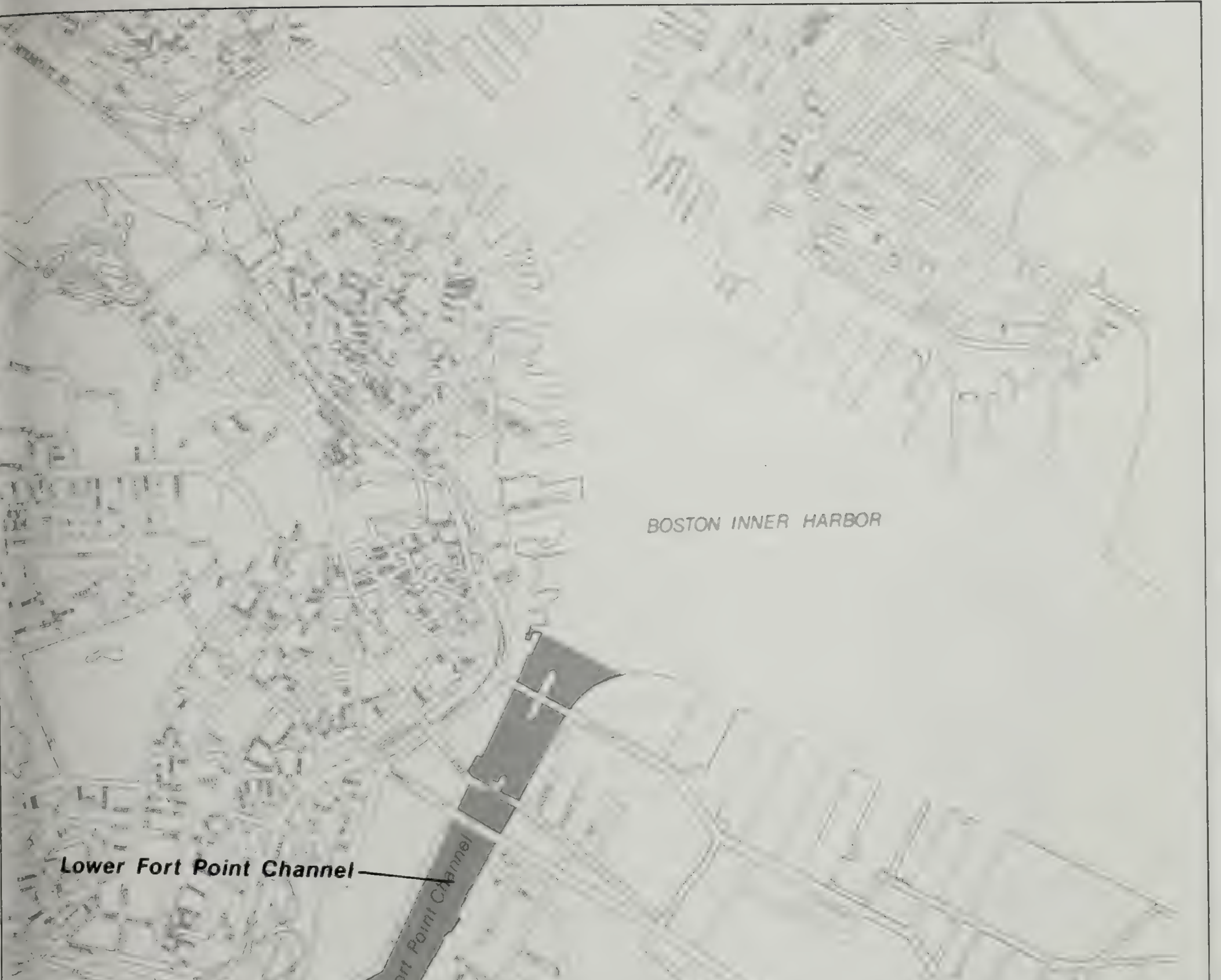
Below the dam and the North Washington Street bridge is a privately owned wharf property that is being planned for mixed use redevelopment. Constitution Plaza, which was developed on Massport piers, includes an office building and restaurant as well as a large, active marina.

The Charlestown waterfront is accessible in the vicinity of the Paul Revere Landing Park, and a major pedestrian route crosses the Gridley Locks to the North Station area.

14.1.2 Fort Point Channel

14.1.2(a) Area Description

Fort Point Channel is a moderately deep waterway (generally 26 feet in depth below mean sea level) located between Boston's Central Business District to the northwest and South Boston to the southeast (see Figure 14.8). Its shallowest depth is 11 feet because the Channel bottom is not even but rather undulating. It is approximately 5,500 feet long and about 600 feet wide at its mouth. Rectangular in shape, the mouth of the Channel faces north/northeast and enters the middle of Boston Inner Harbor at an angle from the south/southwest. The length of the tidal excursion is approximately 2,100 feet. Computations have indicated that the average current velocity of water entering or leaving the Channel at the Northern Avenue bridge is approximately 0.1 foot per second (fps) with a range of 0.03 to 0.17 fps. As a result of the orientation of the Channel to the Inner Harbor, the currents of the Harbor pass perpendicularly to the flow of current in the Channel. This tends to reduce current velocities in the Channel and create variable flow patterns at its mouth. (For more detail on the tidal prism, see Chapter 13.)



Note: Dorchester Avenue is the dividing point between Upper and Lower Fort Point Channel.

FIGURE

14.8

Fort Point Channel Location Map

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

The reach of Fort Point Channel upstream of the Dorchester Avenue bridge is sometimes referred to as South Bay, or Upper Fort Point Channel. South Bay was formerly an extensive embayment, but it has largely been filled. The reach of Fort Point Channel downstream of the Dorchester Avenue bridge is sometimes called Lower Fort Point Channel. There are no obvious shoreline constrictions along Fort Point Channel.

14.1.2(b) Wetland Resources

Field studies have identified three resource areas within Fort Point Channel. These are: (1) tidal waters, (2) coastal mudflats, and (3) coastal wetlands. The following sections describe each of these resource areas in further detail.

The coastal banks are largely manmade. The banks consist primarily of rock bulkheads and revetments, although areas of riprap, rubble, piers, and pilings also are present. (Figure 14.9 is an illustration of typical coastal banks in the Channel.)

Within Fort Point Channel, a total of 0.83 acre of coastal mudflats has been identified. These areas are located in the South Bay area, north of the Dorchester Avenue bridge. The coastal mudflats are subject to tidal influence, being at least partially exposed daily. Water quality is the same as that of the adjacent tidal waters.

Coastal wetlands adjacent to Fort Point Channel have been delineated in accordance with the Federal Manual for Identifying and Delineating Jurisdictional Wetlands. A total of 2,570 square feet (0.06 acre) of wetlands were delineated in one location. (Figure 14.10 indicates the locations of the resources.) The limits of wetland hydrology were assumed to be the maximum annual high tide. Portions of the wetland are, therefore, subject to tidal influence at least daily. A small area of reed grass immediately adjacent to the open waters was observed to have a high water line as evidenced by discoloration of the stems. Otherwise, the vegetated areas did not show indicators of hydrology such as sediment deposits, litter discoloration, or debris lines.

Surface sediments within Fort Point Channel consist of organic mud, silt, and clay. Sediment quality has been examined through the collection of core samples followed by bulk chemical analysis. During preparation of the DEIS/R for the project in 1982 (that ultimately led to the FEIS/R dated August 1985), core samples had been collected and analyzed from four locations along the project alignment (see Figure 14.10). Of those samples, FP-1 and FP-2 are applicable to the alignments under consideration. Data from these cores have been combined with data from two other cores (E-11 and E-61) which were obtained during 1988. (More comprehensive information on metals and hydrocarbon analyses are contained in Technical Report 6 - Materials Disposal Program.)

The sediments are highly contaminated with a gradation to improved conditions deeper into the materials. The surface sediments were found to contain concentrations of metals and petroleum hydrocarbons that are well into the Category III level (highly contaminated). Lower concentrations are found in deeper sediments such that at a depth of 18 feet most parameters are within the Category I limit (uncontaminated).

Extraction procedure toxicity testing was conducted to determine if the sediments should be considered as a hazardous material. The results of these tests indicate that the leachate was well within (10 to 100 times lower than) the maximum allowable EPA concentration limit, and thus are not defined as hazardous.

Sediments associated with these mudflats are generally silts and muds. Sediment quality is expected to be similar to that of the adjacent tidal waters.

Substrate conditions in the wetlands are highly disturbed and consist of a variety of fill materials. This is the only area of Fort Point Channel which does not contain a bulkhead.

While there are no data on suspended solids in Fort Point Channel, information available on the Roxbury Canal Conduit indicates an annual discharge to the Channel of 1.3 million pounds of suspended solids. Suspended solids concentrations vary between dry and wet weather conditions. Clarity in the area of the proposed construction is dependent on the quality of water from the Roxbury Canal Conduit. It is not uncommon to find that water in the South Bay or Upper Fort Point Channel has variable water colors from unknown upstream discharges. The Massachusetts Water Resources Authority (MWRA) is developing plans to reduce sewage didischarges to the Fort Point Channel through its combined sewer overflow (CSO) improvements program.

Extensive field work has been conducted throughout Fort Point Channel, and no rooted marine vegetation has been found. Marine algae, such as *Fucus* sp. and *Ulva* sp., that has drifted into the Channel with wind and tide, have been found.

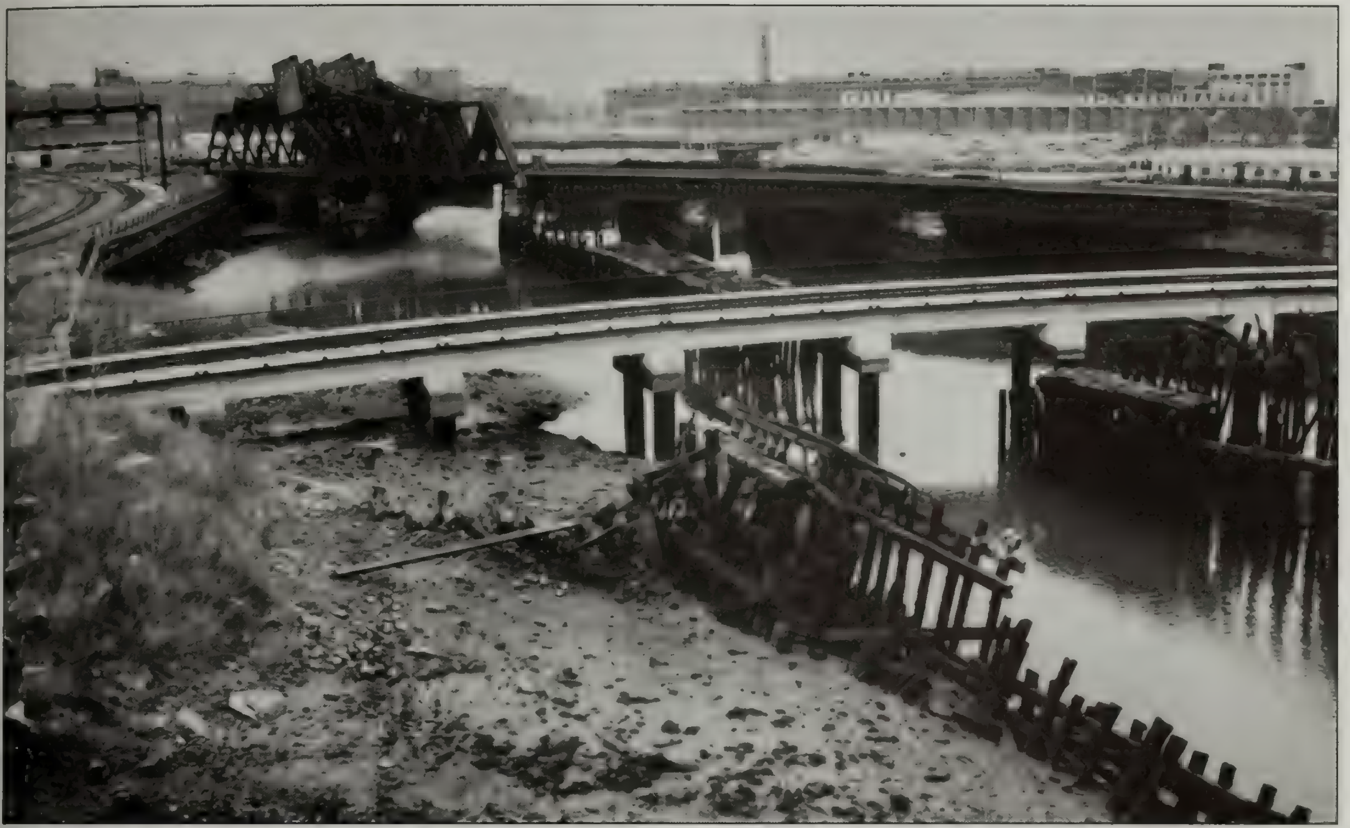
No vegetation or shellfish have been observed on the mudflats. Benthic populations are expected to be similar to those reported for the adjacent tidal waters. Biological conditions are, therefore, degraded.

Vegetation in the coastal wetlands below the maximum annual high tide line is dominated by reed grass. Red goosefoot and seaside goldenrod also are present, along with other species. On the upper, steeper portions of the banks, reed grass, wormwood, spotted knapweed, and Canada goldenrod are predominant. Finally, on the level areas adjacent to the banks, wormwood, ragweed, red clover, India lovegrass, and perennial ryegrass, among others, are predominant. Table 3.13 in the 404(b)(1) Guidelines Appendix lists the plant species observed, their common and scientific names, and the frequency with which they occur in wetland situations.

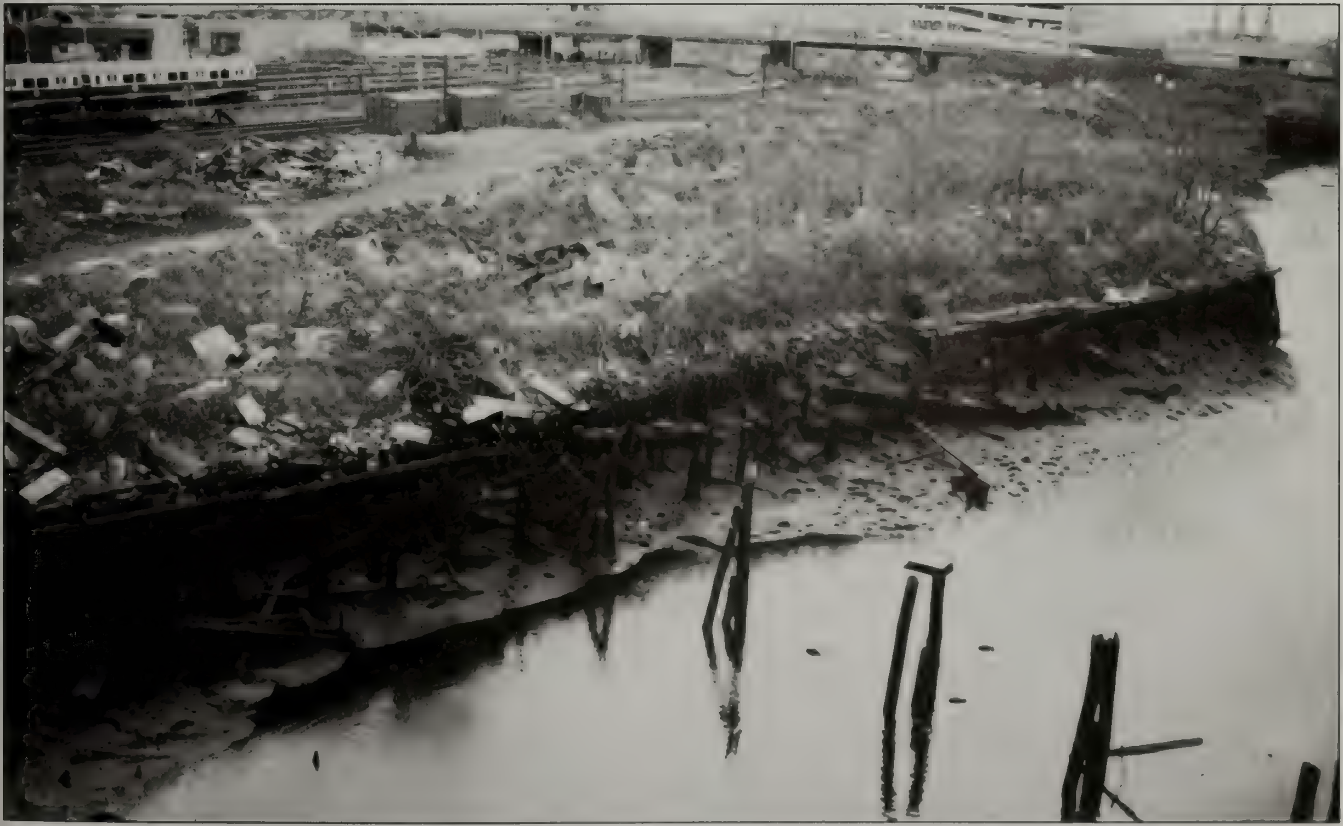
During the data collection phase for the DEIS/R, two sediment samples along the west side of Fort Point Channel were collected and analyzed for benthic macroinvertebrates. These data indicate that the diversity of marine life in the bottom sediments is low, with a high preponderance (greater than 99 percent of the sample) of pollution-tolerant worms (*Capitellidae*). The benthic species have been reported with the Fort Point Channel project area. Shannon-Weiner species diversity was found to range from 0.04 in the area of the proposed construction to 1.67 near the mouth of the Channel.

There are no site-specific data on the fish community in Fort Point Channel. However, examinations of the travelling screen at the Gillette cooling water intake indicate that fish life found in the Channel includes flounder, stickleback, and mummichog. Other finfish likely to occur in the Channel include smelt, alewife, eel, and others that may enter from the Harbor.

The only shellfish that has been found in the project right-of-way was *Tellina agilis*, a small bivalve with no commercial value. Examinations of the 0.83 acres of mudflats in the South Bay have indicated the absence of shellfish.



View of the southern end of Fort Point Channel with wye connector in foreground.



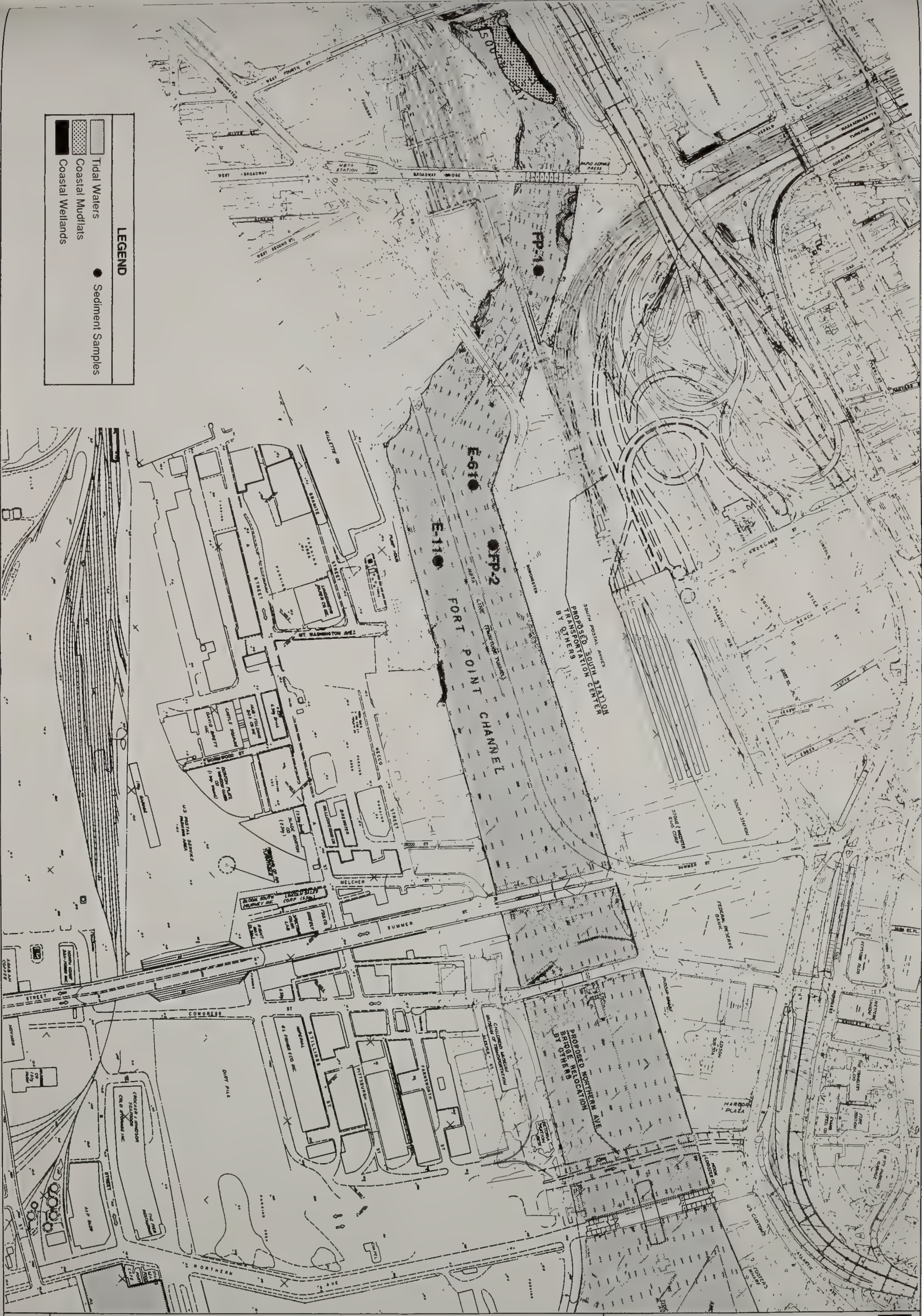
Coastal bank of southern end of Fort Point Channel.

FIGURE

14.9

Typical Fort Point Channel Coastal Banks

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



FIGURE

14.10 **Resource Areas And Sampling Locations At Fort Point Channel**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 200 400 Feet

Minimal wildlife use of Fort Point Channel has been observed. The most common species include cormorants and gulls which feed and rest in the area. Diversity and abundance is limited by adjacent disturbance and lack of diverse habitat.

The functions that this resource area could potentially perform are:

- o flood control capacity
- o storm damage control
- o fisheries habitat
- o wildlife habitat
- o recreational boating

The resources in Fort Point Channel are less important for flood control and storm damage prevention than adjacent bulkheads and revetments, which perform these functions better than the existing tidal flats which lose these functions during high tide. The banks are manmade and engineered to stabilize the shoreline.

Due to the nature of the sediments, which are highly contaminated, and the poor water quality, the Channel is only moderately important as a resource area for fisheries habitats. However, some species do enter the Channel from the Harbor, although the diversity is low. Fish species collected from the screen of the Gillette Company cooling intake include flounder, stickleback, striped bass, and mummichog. Other finfish likely to occur include smelt, alewife, and eel. Field investigations revealed that neither the small tidal flats nor the manmade banks contributes significantly to fisheries habitat. While low densities of shellfish have been found in the Channel near the Northern Avenue bridge, they are not common in this location. There are no shellfish beds mapped under the WPA regulations in this area. No food or fiber production occurs in this resource area. Additionally, the area does not meet any mineral needs.

Wildlife habitat also is limited. Diving birds such as cormorants use the Channel as a feeding area, and therefore it is moderately significant as wildlife habitat. However, the substrate supports only minimal vegetation and invertebrates and provides only a limited feeding area. The tidal flats, due to their small size and the contaminated nature of the sediments, do not provide any significant wildlife habitat.

[For more details, see Section 3.6 of the 404(b)(1) Guidelines Appendix.]

14.1.2 (c) Waterway/Flowed Tidelands

There is limited navigation on the waterway today, due to the lack of any major attraction upriver in the Channel and the constraints placed by the Northern Avenue, Congress Street and Summer Street bridges. For all practical purposes, the Congress Street bridge is the upper limit of major commercial and recreational navigation. The horizontal and vertical clearances of the Northern Avenue bridge at the mouth of the Channel, along with the 11-foot controlling (or shallowest) depth, substantially limit navigation in the Channel. Occasionally, recreational craft use the Channel upriver of the Congress Street bridge.

Fort Point Channel is officially non-navigable upstream of the Dorchester Avenue bridge which has been declared "non-navigable" by Congress (33USC.56). (Navigational constraints in Fort Point Channel are listed in Table 14.1.)

No commercial fishing or shellfishing takes place in Fort Point Channel. However, two wholesale lobster dealers are located on the Channel adjacent to the Northern Avenue bridge. Lobster boats also are berthed in this area.

No water transportation exists within Fort Point Channel at this time. Due to the navigational limits imposed by the low bridges crossing the Channel, the potential for future water transportation opportunities is limited to the area east of the Congress Street bridge and is constrained by the height of the new Northern Avenue bridge, currently under construction.

14.1.2(d) Waterfront/Filled Tidelands

The land use along the vicinity of the Fort Point Channel crossing is a mixture of transportation, office, vacant land, and manufacturing. Public access is available along portions of the waterway, primarily on the South Boston side of the Channel, between the Northern Avenue bridge and Summer Street. Other major water-related activities in the area include floating and Harborfront restaurants, a floating office building, and the Boston Tea Party historical exhibit. This area is one of the most actively used publicly accessible portions of the downtown waterfront.

Elsewhere along the Channel vacant land, buildings, parking lots, and rotting piers preclude public access. A narrow sidewalk runs along Dorchester Avenue, providing limited access along the length of the Channel. The City of Boston Harborpark Plan calls for continuous public access along the entire waterfront. However, at present, this portion of the Fort Point Channel area has very limited public access opportunities.

The marine-dependent businesses located along Fort Point Channel include a marine contractor, two wholesale and retail lobster dealers, a recreational marina, and a private rowing club. The other water-dependent use located along Fort Point Channel is the Gillette manufacturing plant which relies on the Channel for cooling water (see Table 14.3).

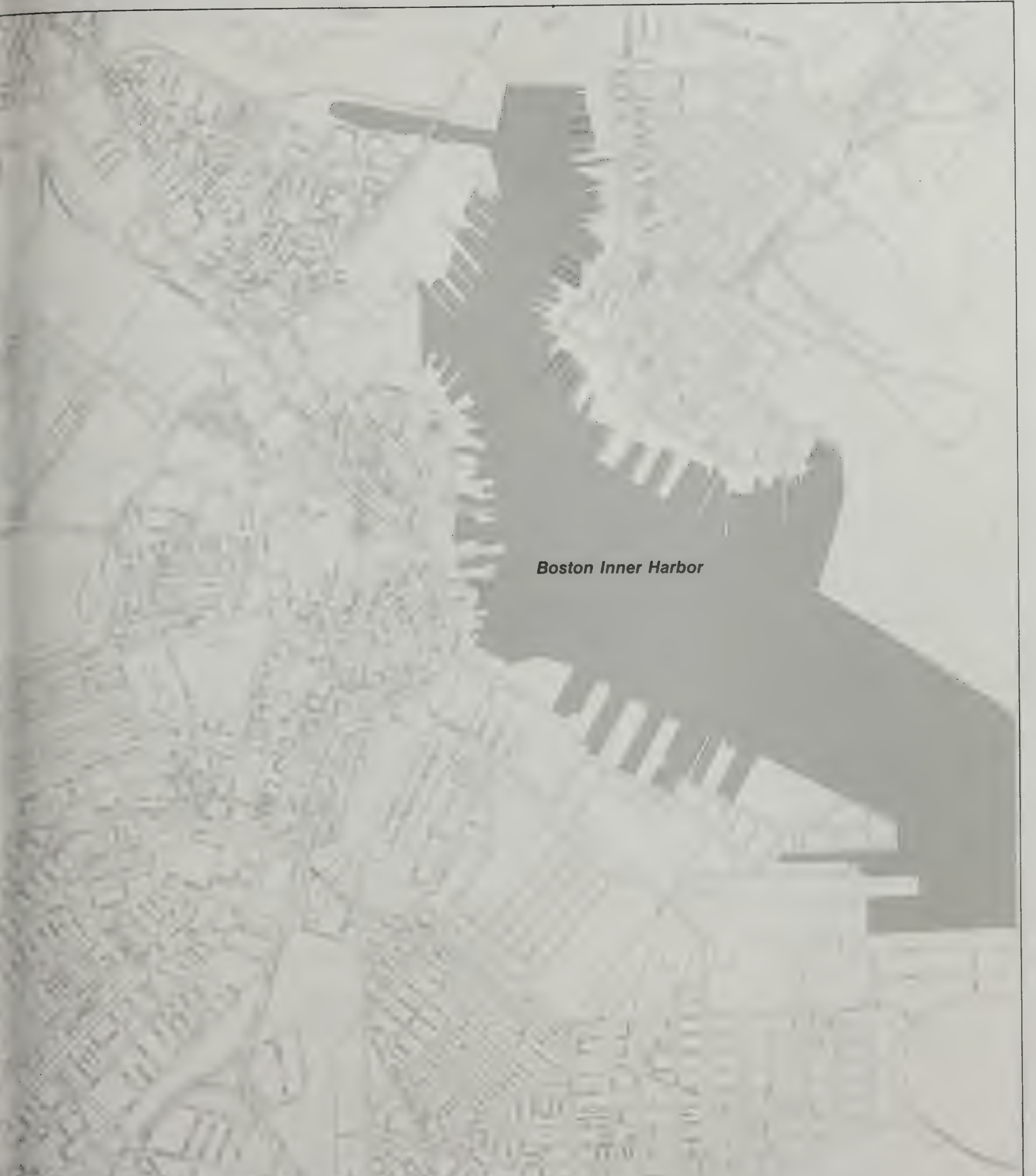
14.1.3 Boston Inner Harbor

14.1.3(a) Area Description

Boston Harbor frequently is divided for discussion purposes into the Inner Harbor and the Outer Harbor. The Outer Harbor begins at Governor's Island and extends seaward to Broad Sound. The Inner Harbor is located on the northwest edge of the Outer Harbor and is approximately 3 miles long and 0.5 mile wide (see Figure 14.11). In general, water depths exceed 20 feet, much deeper than most of the Outer Harbor. In this chapter, only Boston Inner Harbor is discussed.

Boston Inner Harbor is subject to two tidal cycles a day with a maximum difference between successive high or low tides of 1.6 feet. The mean tidal range of the Harbor is 9.5 feet, which increases to 11.0 feet during spring tide conditions. Maximum spring tides can produce elevations of 2.3 feet below mean low water (MLW) and 2.6 feet above mean high water (MHW) (Levin and Fitzgerald, 1981). High tide levels can increase substantially as a result of regional storm surges. Depths in the area average 35 feet at MLW.

Measurements of current speed and direction were conducted at four locations on spring (high) and neap (low) tidal cycles during March 1982 for the FEIS/R. Data from two current



FIGURE

14.11 **Inner Harbor Location Map**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 14.3

INDUSTRIAL SEAWATER USE IN THE BOSTON HARBOR AREA

	Name	Location	Primary Use	Maximum Daily Use (mgd)[1]
Fort Point Channel				
1.	Gillette Company	Gillette Park South Boston	Cooling	57.60[2]
2.	James Hook & Co.	15 Northern Avenue South Boston	Lobster Support	5.00
3.	Neptune Lobster	88 Sleeper Street South Boston	Lobster Support	1.00
Boston Harbor				
4.	General Ship	300 Northern Avenue South Boston	Fire Pumps	2.16
5.	Massport/Bethlehem Steel Shipyard	265 Marginal Way East Boston	Cooling	0.28
6.	Massport	Fish Pier, South Boston	Washdown	0.43
7.	Bay State Lobster	379 Commercial Street Boston	Lobster Support	4.32
8.	Hines and Smart	33 Mill Street East Boston	Lobster Support	2.16
9.	Harbor Lobster	Fish Pier, South Boston	Lobster Support	1.44
10.	Pauls Lobster	150 Northern Avenue South Boston	Lobster Support	1.50
11.	Yankee Lobster	272 Northern Avenue South Boston	Lobster Support	0.86
12.	New England Aquarium	Central Wharf, Boston	Marine Aquarium	0.15

---

[1] Millions of gallons per day

[2] Present use: 37 mgd; stated capacity is 57.6 mgd

Source: Jason M. Cortell And Associates, Inc.

meter stations which are very close to the proposed tunnel alignment indicate peak velocities of 1.0 fps during spring tides. The predominant velocities ranged from 0.10 to 0.26 fps. During ebb tide, higher current velocities were found to occur in the middle and bottom of the water column. This may be related, in part, to the freshwater input from the Charles and Mystic Rivers. The less dense fresh water is stratified over the more dense seawater, flowing counter to flood tides and enhancing slightly the ebb velocities at the surface. (Details on the tidal prism can be found in Chapter 13.)

The small fetch within the Inner Harbor limits the size of wind-generated waves; hence, tidal currents dominate. Because of successive filling during Boston's development, the hydrographic characteristics of the Harbor have changed significantly and now the currents within the Inner Harbor are oriented primarily along the channel (navigational).

The Harbor is used by a variety of commercial vessels including container ships, general cargo ships, fishing boats, car carriers, deep draft oil and other bulk carriers, and other shipping and vessels needing repair and conversion. In addition to commercial vessels, the Harbor and waters seaward are used for a significant amount of recreational boating. (Chapter 3, Transportation, provides additional information on the types and frequencies of vessel movements.) Industrial surface water uses within Boston Inner Harbor include:

o General Ship	2.16 mgd for fire pumps
o Massport	0.43 mgd for washdown of the fish pier
o Massport	0.28 mgd at the Cashman Marine Works
o Hines and Smart	2.16 mgd for lobster support
o New England Aquarium	0.15 mgd for the marine aquarium
o Bay State Lobster	4.32 mgd for lobster support
o Harbor Lobster	1.44 mgd for lobster support
o Pauls Lobster	1.50 mgd for lobster support
o Yankee Lobster	0.86 mgd for lobster support

Table 14.3 lists seawater uses in further detail.

No public or private uses of water for human consumption occur and no known groundwater uses are present.

Major docks and berths in the Harbor include the Subaru Pier, the Rowes Wharf commuter ferry, and the airport shuttle terminal. (Marinas, wharves, and piers in the Inner Harbor are listed in Table 14.1.)

14.1.3(b) Wetlands Resources

The substrate in the sections of the Boston Inner Harbor of concern here consist of mud, silt, and clay. Sediment samplings conducted in January 1987 indicate a varying level of contaminants by such metals as arsenic, chromium, copper, mercury, lead, and zinc. The shipping channel contained higher levels of metals, oil, and grease. The bioassay tests indicated that the sediments sampled were nontoxic. The USACE has reviewed the bioassay data for the sediments to be dredged between South Boston and Bird Island Flats, and has notified the Department in correspondence dated September 22, 1988, that the material has met the criteria in CFR 40 220-227 for disposal of dredged material in ocean waters.

Marine life in the Inner Harbor consists of pollution tolerant polychaete worms. About 90 benthic macroinvertebrates have been identified; *Capitella capitata* and *Polydora ciliata* dominate the benthic community. (The species list is shown in Table 14.4.)

Nearly 4 dozen species of finfish have also been observed in Boston Harbor waters (see Table 14.5). One of the most common is the winter flounder which spawns and remains in such areas as Dorchester Bay and the Outer Harbor year-round. Finrot disease has been reported to be common on flounder and is attributed to the overall poor water quality condition of the Harbor.

Anadromous fish (ocean fish that spawn in fresh water) include rainbow smelt and blueback herring which are prevalent in the spring, and alewife which are found in the early summer.

Flounder spawn throughout Boston Harbor and a moratorium on dredging activities has been imposed on a number of waterfront construction projects during the period of March 15 through June 15 (310 CMR 10.35). The reason for the moratorium is to protect the flounder during reproduction and egg development.

There are no mapped shellfish beds along the tunnel alignment. Within the Inner Harbor, harvestable shellfish beds are located in Winthrop Bay at Governors Island Flats, at Snake Island, and at the intertidal areas north of Logan Airport and near Constitution Beach, Belle Isle Inlet, and intertidal flats around many of the Outer Harbor islands. These are open to harvesting by Master Diggers only, and the shellfish must be purged of bacteria in a clean environment prior to sale. Soft-shell clams have been reported at the head of Jeffries Cove near Logan Airport. These are located at the outfall of a combined sewer overflow and are permanently closed to harvesting.

No rooted vegetation such as turtle grass or eel grass has been found in or close to the proposed construction area. Eel grass has been reported in shallow waters of the Outer Harbor and Dorchester Bay. However, within the Inner Harbor, there is little to no natural habitat for these plants to establish themselves.

Both green and brown algae are common within the Inner Harbor growing on riprap and piles. The most frequent species include *Fucus* (rockweed), *Ulva* (sea lettuce), and a number of filamentous algal species.

Species of marine mammals periodically found in the Harbor include the harbor seal, harbor porpoise, and grampus. Wildlife diversity and abundance is limited by the lack of habitat diversity. However, the Inner Harbor does serve important feeding and resting functions for particular species of waterfowl.

The coastal banks of the Boston Inner Harbor, along the project area, consist entirely of manmade bulkheads and revetments. The Inner Harbor has two State-designated port areas located in South Boston and East Boston. In addition, it is important for recreational uses and highly important for industrial surface water use.

The functions that this resource area could potentially perform are:

- o flood control capacity
- o storm damage control

Table 14.4

SPECIES LIST OF BOSTON INNER HARBOR MARINE BENTHIC MACROINVERTEBRATES

- IDARIA (Hydroids, Jellyfish, Anemones)
  - *Hydrozoa*
    - *Abietinaria* sp.
    - *Bougainvillia* sp.
    - *Campanulaira* sp.
    - *Thuiaria* sp.
  - *Scyphoza*
    - *Aurelia aurita*
  - *Anthozoa*
    - *Metridium senile*

- NEMATODA (Roundworms)

- ANNELIDA (Segmented Worms)
  - *Oligochaeta*
    - *Peloscolex gabriellae*
    - *Tubifex* sp.
  - *Polychaeta*
    - *Aglaophamus circinata*
    - *Asabellides oculata*
    - *Asychis elongata*
    - *Capitella capitata*
    - *Capitella gracilis*
    - *Caulleriella fillariensis*
    - *Cirratulus grandis*
    - *Cirratulus* sp.
    - *Cistenides gouldii*
    - *Eteone longa*
    - *Eteone heteropoda*
    - *Harmothoe extenuata*
    - *Harmothoe imbricata*
    - *Lumbrineris fragilis*
    - *Lumbrineris tenuis*
    - *Maldane* sp.
    - *Mediomastus ambiseta*
    - *Microphthalmus aberrans*
    - *Paranaitis speciosa*
    - *Pectinaria gouldii*
    - *Pholoe minuta*
    - *Phyllodoce groenlandica*
    - Phyllodoce maculata
    - *Phyllodoce mucosa*
    - *Polycirrus* sp.
    - *Polydora ciliata*
    - *Polydora hamata*
    - *Polydora ligni*
    - *Polydora websteri*
    - *Prionospio malmgreni*
    - *Scolelepis squamata*
    - *Spio filicornis*
    - *Spiophanes bombyx*
    - *Streblospio benedicti*
    - *Tharyx acutus*

- ARTHROPODA (Shrimp, Scuds, Crabs)
  - *Arachnoidea*
    - *Halacarus* sp.
  - *Crustacea*
    - *Subclass Copepoda*
      - *Cyclopoid*
  - *Subclass Malacostraca*
  - *Order Cumacea*
    - *Oxyurostylis smithii*
    - *Edotea* sp.
  - *Order Amphipoda*
    - *Ampelisca abdita*
    - *Ampelisca vadorum*
    - *Corophium (acherusicum)*
    - *Corophium (insidiosum)*
    - *Gammarus duebeni*
    - *Jassa falcata*
    - *Leptocheirus pinguis*
    - *Microdeutopus aromalus*
    - *Nephtys ciliata*
    - *Nephtys incisa*
    - *Nereis accuminata*
    - *Nereis diversicolor*
    - *Nereis grayi*
    - *Nereis succinea*
    - *Nereis virens*
    - *Ninoe nigripees*

Table 14.4 (Cont.)

SPECIES LIST OF BOSTON INNER HARBOR MARINE BENTHIC MACROINVERTEBRATES

- *Notocirrus spiniferus*
- *Ophelia* sp.

MOLLUSCA (Clams and Snails)
- *Gastropoda*
  - *Crepidula fornicata*
  - *Crepidula plana*
  - *Culichna alba*
  - *Mitrella lunata*
  - *Nassarius obsoletus*
  - *Nassarius trivittatus*
- *Bivalvia*
  - *Ensis directus*
  - *Lyonsia hyalina*
  - *Macoma tenta*
  - *Modiolus modiolus*
  - *Mulinia lateralis*
  - *Mya arenaria*
  - *Mytilus edulis*
  - *Tellina agilis*

ECTOPROCTA (Bryozoans)
- *Bowerbankia* sp.
- *Bugula turrita*
- *Triticella* sp.
- *Orchomenella minuta*
- *Photis macrocoxa*

Order Mysidacea
- *Neomysis americana*

Order Isopoda
- *Pannalus borealis*

Order Decapoda
- *Cancer irroratus*
- *Carcinus maenas*
- *Crangon septemspinosus*

Source: Jason M. Cortell and Associates, Inc.

Table 14.5

BOSTON INNER AND OUTER HARBOR FINFISH SPECIES LIST

Common Name	Scientific Name
Alewife	*Alosa Pseudoharengus*
American eel	*Anguilla rostrata*
American sandlance	*Ammodytes americanus*
Atlantic cod	*Gadus morhua*
Atlantic herring	*Clupea harengus harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic silverside	*Menidia menidia*
Atlantic tomcod	*Microgadus tomcod*
Bluefish	*Pomatomus saltatrix*
Blueback herring	*Alosa aestivalis*
Butterfish	*Peprilus triacanthus*
Cunner	*Tautoglabrus adspersus*
Cusk	*Brosme brosme*
Fourspine stickleback	*Apeltes quadracus*
Grubby	*Myoxocephalus aeneus*
Hake	*Urophycis* sp.
Little skate	*Raja erinacea*
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Lumpfish	*Cyclopterus lumpus*
Mummichog	*Fundulus heteroclitus*
Ninespine stickleback	*Pungitius pungitius*
Northern pipefish	*Syngnathus fuscus*
Ocean pout	*Macrozoarces americanus*
Pollock	*Pollachius virens*
Rainbow smelt	*Osmerus mordax*
Red hake	*Urophycis chuss*
Sea snail	*Liparis atlanticus*
Sea raven	*Hemitripterus americanus*
Searobin	*Prionotus* sp.
Sculpin	*Myoxocephalus* sp.
Silver hake	*Merluccius bilinearis*
Smooth flounder	*Liopsetta putnami*
Spiny dogfish	*Squalus acanthias*
Striped anchovy	*Anchoa hepsetus*
Striped bass	*Morone saxatilis*
Striped killifish	*Fundulus majalis*
Threespine stickleback	*Gasterosteus aculeatus*

Table 14.5 (Cont.)

BOSTON INNER AND OUTER HARBOR FINFISH SPECIES LIST

Common Name	Scientific Name
Weakfish	*Cynoscion regalis*
Windowpane	*Scophthalmus aquosus*
White perch	*Morone americana*
Winter flounder	*Pseudopleuronectes americanus*
Winter skate	*Raja ocellata*
Yellowtail flounder	*Limanda ferruginea*

Source: Draft Environmental Impact Statement/Report, Third Harbor Tunnel Project, Interstate 90, Boston, Massachusetts, Appendix 7 - Water Resources, U.S. Department of Transportation Federal Highway Administration, FHWA-MA-EIS-82-02-D, December 1982

- fisheries habitat
- wildlife habitat
- designated port area
- shellfish habitat
- recreational boating

Riprap and bulkheads allow for shoreline stabilization against currents and wave action.

The sediment data indicate that contaminants do accumulate at the location in the Harbor where the tunnel will cross. The accumulation is limited due to high current velocities and exposure to wind effects.

Relative to flood control and storm damage prevention, this resource area is considered to be highly important due to its storage capacity and stability resulting from the reinforced banks.

Boston Inner Harbor is also a designated fish run and is considered to be an important fisheries habitat. Fisheries resources within this waterway are extensive if somewhat degraded due to reduced water and sediment quality. There are no State-mapped shellfish beds in the area where the Third Harbor Tunnel will be built.

No food or fiber production occurs in this resource area. Additionally, the area does not meet any mineral needs.

Wildlife is restricted to the open water areas. The banks are manmade and provide limited perching habitat for birds. Cormorants, gulls, and other waterfowl use the Harbor as a feeding area. It is thus moderately important for the protection of wildlife habitat.

[For more details, see Section 3.6 of the 404(b)(1) Guidelines Appendix. Table 14.6 summarizes the functional assessment of the water bodies. Table 14.7 presents the criteria for the functional assessment.]

14.1.3(c) Waterways/Flowed Tidelands

The primary use of the Inner Harbor area is for commercial navigation. The main ship channel to Boston Harbor runs up the center of the Inner Harbor and is the main route for deep draft vessels proceeding to terminals in the Mystic River and Chelsea Creek areas. These vessels include tankers, freighters, container ships, barges, tugs, and other commercial traffic.

The Inner Harbor also supports deep draft vessels calling at terminals along the South Boston waterfront, including Commonwealth Pier, the Boston Fish Pier, General Ship Corporation, Black Falcon Cruise Terminal, the Boston Marine Industrial Park, the Subaru Terminal, Coastal Cement, Conley Terminal, and other general cargo and bulk terminals. The deep draft vessels utilize the Inner Harbor for approaching and berthing at these terminals.

The Inner Harbor is also the main route for water transportation activities serving Rowes Wharf, Long Wharf, the airport, and the World Trade Center. Water shuttle service is available between Logan Airport and Rowes Wharf and between Long Wharf and the Charlestown Navy Yard. Commuter boats run between Hingham and Hull and the downtown area.

Table 14.6

FUNCTIONAL EVALUATION SUMMARY[1]

	Evaluation Site							
	Millers River		Charles River		Fort Point Channel			Boston Inner Harbor
Function	Nontidal Water	Inland Wetland	Nontidal Water	Inland Wetland	Tidal Water	Coastal Mudflat	Coastal Wetland	Tidal Water
Groundwater								
Groundwater Recharge	L	L	L	L	N	N	N	N
Groundwater Discharge	L	L	L	L	L	L	L	L
Groundwater Supply	L	L	L	L	N	N	N	N
Storm Damage Prevention								
Flood Storage and Desynchronization	M	L	H	L	L	L	L	L
Sediment and Shoreline Stabilization	L	L	H	H	H	L	L	H
Water Quality								
Sediment/Toxicant Retention	H	L	M	L	H	H	L	M
Nutrient Retention/ Transformation	H	L	M	L	H	H	L	M
Surface Water Supply	L	L	L	L	H	L	L	H
Biological Resources								
Nutrient Export	L	L	L	L	L	L	L	L
Aquatic Diversity/Abundance	L	L	L	L	L	L	L	M
Fish Habitat	L	N	H	N	M	L	L	H
Shellfish Habitat	N	N	N	N	L	L	L	L
Wildlife Habitat	L	L	M	L	M	L	L	M
Endangered Species	L	L	L	L	L	L	L	L
Human Resources								
Recreation	L	L	H	L	H	L	L	H
Uniqueness/Heritage	L	L	H	L	M	L	L	M

---

1. Criteria for the following values are presented in Table 14.7: N = Nonfunctional; L = Low Value; M = Moderate Value; H = High Value

Source: Jason M. Cortell, 1986, Aquatic Resources Functions and Values Volume 1: Roadway, Tunnel and Bridge Alternative Assessment, Waltham, MA

Table 14.7

CRITERIA FOR FUNCTIONS AND VALUES ASSESSMENT

Resource	Function	Low Value	Medium Value	High Value
Groundwater	Groundwater Recharge	Default value, except that tidal waters are considered nonfunctional	At least 1 characteristic listed for "high" value	o Water bodies with no outlet o Perched above surrounding terrain o High in watershed
	Groundwater Discharge	No evidence of discharge or area driven by surface waters		o Observed seep or spring o Areas with an outlet but no inlet o Areas with documented high water table
	Groundwater Supply	Default value except tidal waters which are considered to be nonfunctional	Within 1,000 feet of groundwater supply but not within cone of influence	o Adjacent to known groundwater supply and within cone of influence
Storm Damage Protection	Flood Storage and Desynchronization	Tidal areas, except when in conjunction with a large tidal creek or ditch area	Default value	o Area located in empoundment or basin with restricted outlet with recognizable floodplains o Isolated areas, where floodwaters enter but cannot exit
	Sediment and Shoreline Stabilization	Resource areas not adjacent to potentially erosive water features	Areas without ability to stabilize shoreline or reduce water velocity	o Areas with erosion protection structures o Resources exposed to large bodies of open water, wave action, or high velocities unless evidence of erosion is present
Water Quality	Sediment/Toxicant Retention	Resource areas subject to high velocities	o Large shellfish beds (case-by-case) o Default value for uncertainty	o Resource areas hydrolocally isolated and have a sediment load o Areas indicated by water quality data to retain sediment

Table 14.7 (Cont.)

CRITERIA FOR FUNCTIONS AND VALUES ASSESSMENT

Resource	Function	Low Value	Medium Value	High Value
Water Quality (Cont.)				o Areas with flowing water and a depositional environment or having a fine sediment substrata o Vegetated wetlands in the path of flowing water o Large shellfish beds (case-by-case)
	Nutrient Retention/ Transformation			o Apply criteria listed for sediment toxicant retention o Vegetated resource rate higher than unvegetated
	Surface Water Supply	Default value	Areas which may affect the quality of adjacent surface water supplies	Known surface water supply
Biological Resources	Nutrient Export	Unvegetated resource area (resources not part of a functional surface water system will be rated non-functional	Default value	Vegetated resource areas having fluctuating water levels
	Aquatic Diversity/ Abundance	Same as high	Same as high	Analysis of invertebrate data, substrate and water quality data
	Fish Habitat	Vegetated resources in inland wetland unless seasonally flooded and used for spawning		Observed fish species or assessment of habitat if fish not observed

Table 14.7 (Cont.)

CRITERIA FOR FUNCTIONS AND VALUES ASSESSMENT

Resource	Function	Low Value	Medium Value	High Value
Biological Resources (Cont.)	Shellfish Habitat	Default value. Nontidal waters and inland wetlands are assumed to be nonfunctional as shellfish habitat	Shellfish present and of a nature that suggests resource has a moderate value	Shellfish present and of a nature that suggests resource has a high value based on size, condition and location of bed
	Wildlife Habitat	Default value	Resource areas supplying important or unusual habitat value but not all (e.g., mudflat most useful at low tide)	o Observed high wildlife diversity and abundance or records of such observations o In lieu of complete record, vegetated wetland greater than 1 acre with high quality habitat characteristics
	Endangered Species	Default value	Resource areas that may affect the quality of adjacent listed species	Observed use or recorded observation
Human Resources	Recreation	Inaccessible areas	Potentially usable for recreation	Areas with known recreational use
	Uniqueness/Heritage	Neither unique nor of a particular heritage	Default value	Unique to a region or with demonstrated important heritage value

---

Source: Jason M. Cortell, 1986, Aquatic Resources Functions and Values Volume 1: Roadway, Tunnel and Bridge Alternative Assessment, Waltham, MA

Commercial fishing and shellfishing activities occur, to a limited degree, in this section of the Boston Inner Harbor. Commercial fishing is limited primarily to lobstering and a bait fishery for menhaden. Recreational fishing occurs primarily from bridges and piers along the Inner Harbor.

Boston Inner Harbor is an active area for recreational boating. There are yacht clubs and marinas located throughout the Inner Harbor, supporting both sail and power vessels. Recreational cruising also occurs in Boston Inner Harbor and there are a number of excursion boat operations in the Harbor which provide local cruises, transportation to the Boston Harbor Islands, and cruises to Cape Cod and other remote destinations.

14.1.3(d) Waterfront/Filled Tidelands

Both South Boston and East Boston, adjacent to the Boston Inner Harbor contain filled tidelands. The South Boston waterfront is the home to Boston's major port activities and contains a variety of water-dependent uses along the Inner Harbor including the Black Falcon Cruise Terminal, Commonwealth Pier, the Boston Fish Pier, the Subaru Terminal, the Conley Terminal, White Fuel, Boston Edison, and Boston Marine Industrial Park (a 200-acre industrial park which contains 150 firms including Coastal Cement, Pier 7, and General Ship Corporation.) The area includes a Designated Port Area (DPA), and the majority of the space is zoned as a Maritime Economy Reserve Zone by the City of Boston.

On the East Boston side, Boston Marine Works hosts a variety of marine-dependent and marine related uses, including ship repair and services. This area is also a DPA.

Approximately 400,000 tons of cargo per year are handled in the East Boston DPA. Ship repair occurs at General Ship Piers 5 and 6 in South Boston and at the Boston Marine Works facility in East Boston. These facilities are used to moor vessels for repair, conversion, and outfitting. Dry Dock #3 is presently inactive but was previously used for the repair of battleships and aircraft carriers.

The area of the Inner Harbor most directly affected by the project includes the proposed tunnel route from South Boston to East Boston. This area has little if any public access due to incompatibility with existing land uses. Public access in the area in and around the Third Harbor Tunnel approaches does not presently exist on the South Boston side, due to the security requirements of two water-dependent industrial uses, General Ship Corporation and the Subaru Terminal. On the Logan Airport side, public access is not encouraged due to airport-related functions.

Public access is available elsewhere along the Inner Harbor, particularly in downtown Boston, and at the World Trade Center, Fish Pier, and Boston Marine Industrial Park on the South Boston side, and along the Harbor from the Logan Airport water shuttle dock to the Jeffries Yacht Club in East Boston. General Ship uses industrial surface water of the Inner Harbor for fire pumps, and Boston Marine Works draws water from the Inner Harbor. Several lobster wholesalers on both sides of the Harbor depend on Harbor water for holding tanks.

14.2 ENVIRONMENTAL CONSEQUENCES

This section identifies the Artery/Tunnel Project activities that could affect the wetland and waterway resources of the three water bodies affected by the project alignment and assesses the impacts that these activities could have on their functions. [Activities and impacts that occur during the construction phase of the project are discussed in Chapter 20. Table 14.8 shows the projectwide areas and volumes of fill in the three affected resource areas. A comparative impact assessment of various alternatives to the Proposed Action can be found in Part II of the SEIS/R and in Chapter 4 of the 404(b)(1) Guidelines Appendix.]

14.2.1 Lower Charles River And Millers River

14.2.1(a) Long-Term Impacts

The activities in this area that could generate long-term impacts are:

- o I-93 bridges and ramps
- o fill resulting from pier placement
- o demolition of the existing I-93 bridge
- o removal of all but one pier (pier A) of the existing I-93 bridge (Charles River only)

Proposed project structures and work in the Lower Charles River and Millers River include the three new bridges over the Charles River -- the I-93 northbound, I-93 southbound, and the Storrow Drive connector/Route 1 bridges -- all to be placed upstream of the existing Charles River bridge. The I-93 bridges will be single-deck bridges, and the Storrow Drive connector/Route 1 bridge will be a double-deck bridge. At most, 17 new cylindrically shaped bridge piers 15 feet in diameter will be placed in the waters of the Charles River to support the three new bridges. In addition, there will be ramps and a cloverleaf structure east of and above the Millers River. Eight new piers will be placed in the Millers River.

The existing Central Artery bridge over the Charles River will be demolished and all but one of the piers will be removed down to the mudline. Pier A -- the so-called "reversed banana pier" -- will remain in the water to maintain the existing uniform flow approach to the pump station downstream.

14.2.1.(b) Wetland Resource Impacts

Removal of existing and placement of the new bridge piers in the Charles River will displace a net area of 24 square feet of river bottom. The river banks are currently riprapped and will not be disturbed. Direct habitat losses in the Charles River represent a reduction in productive, valuable habitat. The amount of loss has, however, been minimized as the Proposed Action has the least impact of all the design options considered in this area (see Chapter B1 of Part II). Direct habitat losses in the Millers River have substantially less impact, because it is highly polluted and has low biological productivity.

Construction of the new supporting bridge piers will require the filling of 54,400 cubic feet in the Charles River (3,200 square feet times an average depth of 17 feet). However, 54,000 cubic feet of piers from the existing Charles River bridge will be removed. This negligible difference represents 0.003 percent of the available water volume between the old and new dams. The loss of this small amount of diluting water for pollutants would have no significance to water quality concentrations. Therefore, there will be little or no impact to water quality in the Charles River.

The Millers River has a drainage area of approximately 1,000 acres. The average annual flow is approximately 3 cfs and the 7-day, 10-year low flow is essentially zero. The open water

Table 14.8

ARTERY/TUNNEL PROJECTWIDE FILL VOLUMES AND AREAS 1985 FEIS/R AND 1989 SEIS/R

	Volume[1] (yd)		Area[1] (acres)			
Locations	**1985**	**1989**	**1985**	**1989**	**Comparison of 1989 SEIS/R (Proposed Action) to 1985 FEIS/R**	**Type of Fill**
Boston Inner Harbor - Slip east of General Ship dry dock	0	5,330	0	0.07	Increase	Rock and cement
Charles River	12,000	14.8	1.37	0.12	99.9% Reduction (vol.) 91.2% Reduction (area)	Structural and reinforcement steel and concrete
Millers River	0	355	0	0.51	Increase	Structural and reinforcement steel and concrete
Fort Point Channel	616,690	206,600	20.81	8.40	66.5% overall reduction (vol.) 59.6% overall reduction (area)	
- South Bay Area	440,440	112,200	13	4.0	74.5% reduction (vol.) 69.2% reduction (area)	Earth, gravel
- Tunnel Box	176,250	94,400	7.81	4.40	46.4% reduction (vol.) 43.7% reduction (area)	Earth, gravel, concrete
TOTAL	628,690	212,300	22.18	9.05	66.2% reduction (vol.) 59.2% reduction (area)	

---

1. For tidal areas, below mean high water
2. 1989 refers to the year this work was undertaken, not the publication date of the SEIS/R

Source: Bechtel/Parsons Brinckerhoff

area of the river is 1.7 acres and the volume is approximately 222,000 cubic feet. The average annual flushing rate is once per day. Since the low flow rate is essentially zero, there is no flushing under this condition.

Construction of the supporting bridge piers in the Millers River will require the filling of approximately 9,600 cubic feet of water (eight piers with an area of 20 feet by 20 feet times 3 feet of water). This is 4 percent of the total water volume in the Millers River and also represents no significant loss of dilution capacity. As described in 14.1.1(b), water quality in the Millers River has been found to be degraded such that fish and invertebrates cannot inhabit the area. Because the river flushes daily (due to its limited volume), its water quality is totally dependent on the quality of the discharges of storm sewers into the waterway. There is no capacity to dilute pollutants until the water is close to the outlet to the Charles River because of the degraded water quality. It could be argued that given the loss of dilution water, the pollution level could increase by 4 percent. However, due to the high average flushing rate, and poor quality of contributing water, there will be no significant change in terms of water quality concentrations.

Since the piers in the Charles River will be small and cylindrically shaped, they will cause a minimal amount of hydrodynamic disturbance. Furthermore, they are to be placed sufficiently upstream so that any disturbance to the flow will not affect the proper functioning of the pumping station downstream. Water velocity of the Charles River also is slow enough that any disturbance to the flow would have minimal effect. During the construction of the piers which will take place behind steel sheet cofferdams, water quality of the river will be affected. (Description of construction details are found in Chapter 20.)

Although not designated as such by the Massachusetts Division of Marine Fisheries, the Charles River has a warmwater fishery and an anadromous run. The bridge piers will not obstruct the fish run since the fish will swim around them. The function that the existing banks perform in terms of fisheries and wildlife habitat will be replaced by the reconstructed banks. The submerged parts of the pier structures and the associated increase in additional fish shelter may contribute to an improvement in fisheries habitat, although the change is not expected to be substantial.

14.2.1(c) Aquatic Impacts

The construction of new bridges over the Charles River will cause additional shading to occur on the river and along the shoreline. The water residence time in the 4.4 acres of the Charles River that will be under the new bridges is short due to its proximity to the dam. A very small amount of food chain organisms such as phytoplankton and zooplankton originate in the shaded area. However, most of the volume originates in the large basin above the old dam and drifts downstream with the water flow. The banks of the Charles River are steeply sloped or vertical and there are no shallows to support rooted aquatic vegetation. Therefore, the impact of additional shading on these organisms is not an issue, even though plankton photosynthesis may be reduced.

Freshwater fish typically seek out areas such as those under overhangs, structures, and similar objects that are shaded and provide shelter. Fish do not stop swimming at dusk and wait for sunrise to resume swimming. The most likely impact to resident freshwater fish will be some net movement to the new open water shadowed areas.

Anadromous fish are driven upstream by migratory instinct for reproduction. The response of shad, alewife, smelt, and blueback herring which migrate up the Charles River will be species specific. Boyd Kynard of the U.S. Fish and Wildlife Service reports that while adult shad migrate during the day and night, the juveniles migrate more at night. From field observations at a Holyoke power canal on the Connecticut River, it has been noted that adult shad stop swimming at the edge of a shadow cast by a bridge over the canal. The juveniles enter the shadow and stay within it. After the shadow has disappeared (by cloud cover or dusk), fish movement resumes. Alewife have lower movement under high light intensity and move greater distance under lower light. Blueback herring have been found to approach a shadow, dive to deeper water, swim under the shadow, and then move upward in the water column beyond the shadow.

The presence of a shadow, then, has different impacts to different species of anadromous fish. Adult shad may temporarily stop their migration in front of the shadow and then proceed after cloud cover or dusk has removed the sunlight. The juvenile shad will stop within the shadow and resume movement after cloud cover or dusk has removed illumination. Alewife will most likely be unaffected, and blueback herring will swim to deeper waters and pass through the shadow.

From the above reports, it can be seen that the presence of a shadow, not its width or length, that alters their behavior. Therefore, whether the shadow is 100 or 400 feet in width will have no bearing on the behavior of the anadromous fish. There are no reported problems with the present shadow from the bridges and structures over the Charles River and in the future it is unlikely that there will be any additional problems.

In summary, the increased shading caused by the proposed bridge construction may cause some short-term (measured in hours) delay in shad migration, but should not cause any long-term impediment to normal fish behavior.

In terms of impacts to spawning of freshwater fish, the area immediately behind the Charles River dam is not all that amenable to spawning because of steep or vertical banks and the lack of shallows containing wetland and freshwater vegetation and snags. Many of the freshwater fish that inhabit the Charles River spawn by broadcasting their eggs in shallows, over snags and vegetation. Others such as the bass, white perch, and brown bullhead nest in the shallows. This type of habitat is simply not present within the area immediately behind the new Charles River dam nor under the proposed structures. Therefore, the impact to reproduction of freshwater fish will be minimal.

Anadromous fish such as shad, alewife, and herring spawn well upstream of the proposed structures. Smelt typically do not move far upstream from the point at which they entered the freshwater system. They may spawn between the new and old dams or above the old dam. Spawning takes place mostly at night by broadcasting the eggs which will stick to piers, vegetation, and snags. Therefore, given either the spawning location, and/or the time of spawning (at night) it does not appear that the proposed structures or shadow would have an impact on the spawning of anadromous fish.

The piers crossing the Millers River will preempt 3,200 square feet of river bottom, adjacent banks, and bordering vegetated wetlands. The reed grass stands, although generally of low quality, do perform flood control and storm damage functions by anchoring the banks and slowing water runoff speeds. They also attenuate pollution by filtering sediments. This loss, however, is not anticipated to have a serious impact on the resource area's ability to provides storm damage prevention or flood control since the banks of the river are high. It is expected that the piers will not obstruct water circulation and flow of water into the Charles River.

The proposed southbound I-93 bridge over the Millers River will be approximately 40 to 45 feet above the river. Due to this height, shadows will be cast over the river during certain parts of the day, but indirect sunlight will allow for adequate plant growth, such as occurs along the southern bank which is shaded by existing bridge structures. The composition of plant species would shift to those that are more shade-tolerant.

The bordering vegetated wetlands at Millers River do not provide public or private water supply or groundwater supply functions. However, they do provide some wildlife habitat. Currently, it is estimated that 19,165 square feet of the bordering vegetated wetlands will be disturbed due to construction. Several areas adjacent to the project have been studied as possible Millers River relocation sites. Wetlands replacement and landscaping as appropriate will be undertaken at the Millers River.

Tables 14.9 and 14.10 summarize both short-term and long-term impacts to the two resource areas. Detailed discussions on short-term impacts are found in Chapter 20.

14.2.1(d) Waterways/Flowed Tidelands Impact

The Charles River is officially navigable with a controlling depth of 35 feet from its mouth to the Charlestown bridge. The new Charles River dam has three locks, the largest of which is 300 feet long and 40 feet wide. Further upstream the old Charles River dam is maintained open and is non-operational. The controlling depth between the two dams is approximately 15 feet. The river is used mainly for recreational boating. There is limited barge traffic (approximately one barge every 6 days).

The proposed Charles River crossing will traverse the area between the two locks just west of the existing Central Artery high bridge. The three Proposed Action bridges (under the worst-case scenario) will have pier spans of 250 feet and will have 17 piers located within the river itself. As a result of the number of piers located in the water, navigational quality in the Inner Charles might be degraded. However, the piers would be placed to allow a 300-foot barge (the largest vessel which can physically lock through the dam) to navigate safely below the bridges with the aid of two tugboats. (Figure 14.10 shows the outline of the surface area required by such a barge in order to pass below the bridges, along with the location of the bridge piers. All smaller barges and other vessels also would be able to navigate safely below the bridges.

The three new bridges will have a vertical clearance of about 30 feet. (The majority of barges navigating the Charles River at present do not exceed 200 feet in length.) Recreational navigation, likewise, is not expected to be seriously impaired.

Shadows cast by the bridges should not degrade the quality of navigation. Vessels navigating beneath the bridge would be travelling at much slower speeds in order to maneuver around the piers, so that the shading is a minor factor in navigation. However, if appropriate, shipping channels below the bridges could be marked with aids to navigation. In addition, all bridge piers will be protected by a fendering system. Plans for fendering

Table 14.9

PROPONENT'S FACTUAL DETERMINATION: MILLERS RIVER (NONTIDAL)

	Short-Term	Long-Term
Substrate	Agitation and disturbance caused by equipment access to drive piles and construct foundations.	Change of 0.43 acre from fine silts and clay to concrete pier. Area outside of pier will remain in its current state.
Water Circulation	No change in circulation patterns or flow rates. Potential decreases in DO and increases in metals resulting from sediment disturbance.	No change from present
Suspended Particulates	Fines will be suspended, thus increasing turbidity. Silt fences will prevent degradation in Charles River.	In accordance with permit conditions
Contaminants	Potential increases from disturbance of existing sediments.	In accordance with permit conditions
Ecosystem	No fish and limited benthic populations are present. 0.44 acre of vegetated wetland above water line will be lost during construction.	The amount of direct sunlight will be reduced by bridge deck. The erosion control, meshing and cover functions of the shoreline vegetation will be provided by reestablishing suitable stands of vegetation that can adapt to the new light conditions.
Mixing Zone	Confined to concrete form	None
Cumulative		No adverse cumulative impact
Secondary Impact	Potential for adverse effect on Charles River. Existing causeway and culverts facilitates control of releases from Millers River.	None expected

Source: Bechtel/Parsons Brinckerhoff

Table 14.10

PROPONENT'S FACTUAL DETERMINATION: CHARLES RIVER (NONTIDAL)

	Short-Term	Long-Term
Substrate	Disturbed by construction of pile cap below the mudline which will be done within a cofferdam. Estimated 8 cofferdams with total area of about 1 acre.	Substantially the same substrate as occurs at present will be used to cover the submerged pilecaps. About .07 acre of concrete pier will extend up through the mud bottom.
Water Circulation	Essentially no change in circulation pattern on flow rate. Cofferdams will be oriented so that their long axis is parallel to the flow of the Charles River. The water surface elevation is controlled by the Metropolitan District Commission.	Essentially no change from present
Suspended Particulates	Elevated suspended solids when cofferdams are being placed, dewatered and removed. Silt screens and other devices will be used to minimize the extent of the increase.	In accordance with permit conditions
Contaminants	Potential increases from disturbance of existing sediments.	In accordance with permit conditions
Ecosystem	Little or none, since work will not be performed in sensitive aquatic resources.	Minor changes induced by shading from bridge deck (.05 acre)
Mixing Zone	Water averages 17 feet deep (maximum depth 24 feet) and has relatively low velocity (1 foot per second) at the narrowest point. Flushes twice daily under normal flow conditions. Silt screens should effectively restrict highly turbid areas in the vicinity of the work area.	None

Table 14.10 (Cont.)

PROPONENT'S FACTUAL DETERMINATION: CHARLES RIVER (NONTIDAL)

	Short-Term	Long-Term
Cumulative		No adverse
Secondary Impact	Degradation of recreational use of Charles River. No substantial effect on tidal area below dam.	None expected

Source: Bechtel/Parsons Brinckerhoff

and any buoy schemes will be reviewed by the MDC and the U.S. Coast Guard, and will comply with all appropriate Coast Guard regulations.

It should be noted that the number and location of the Proposed Action bridge piers is a worst-case scenario. The Department is undertaking studies to refine the bridge design and reduce the number of piers in the water. Possible refinements include a three-bridge option (with an alignment identical to that of the Proposed Action) with a 350-foot pier span, and a four-bridge option with the two mainline movements carried on cable-stayed bridges. These refinements are discussed in further detail in the SEIS/R Part II analysis for the Area North of Causeway Street. (Navigation impacts during construction are discussed in Chapter 20.)

All but one of the existing Charles River bridge piers will be removed down to the mudline. This remaining pier (reversed banana pier) will be clearly marked so that it will not be a navigational hazard.

There will be short-term impacts on navigation due to construction activities, but the long-term impact of the project on navigation is expected to be minimal. Safe navigation through the Charles River will be assured under the proposed project design.

Recreational fishing, a popular activity on the North Washington Street bridge, will be unaffected by the project.

The use of Lovejoy Wharf for the proposed water-dependent use as an excavated materials handling site (i.e., a barge facility) is consistent with Chapter 91 principles of preserving the use of filled and flowed tidelands for water-dependent purposes. It is not in conflict with any existing maritime uses in the area and will be developed in close cooperation with the MWRA and other public or private agencies that also would like to use the wharf for landing of commuter transportation vessels.

14.2.1.(e) Waterfront/Filled Tidelands Impacts

The proposed Charles River crossing will cover a 750-foot-wide segment of the water's edge in Cambridge and Charlestown with large highway viaduct structures. In the North Station area of Boston, the Proposed Action will cover a similar width of the water's edge. Both river banks are filled-in tideland areas. The project will have both positive and adverse impacts on land use, open space, and visual conditions, which vary depending on the particular location within the project. (The land use visual, and open space impacts of the Proposed Action on public access to the waterfront are described in Chapter 8, Land Use and Neighborhood Characteristics, Section 8.2.8, Area North of Causeway; Chapter 9, Visual Characteristics, Section 9.2.1, The Charles River Bridges; and Section 4(f) Evaluation, Section 2.1.)

The following describes the affected environment in terms of Chapter 91 interests of public access, open space, and on-shore facilities supporting water-based activities.

North Station Area. Under the Proposed Action, the elimination of the boat section along the south bank of the river, in favor of an alignment that includes only a bridge abutment, has greatly reduced the adverse impacts of the project on the filled tidelands on the south bank of the river, compared to the FEIS/R. Pedestrian connections from Causeway Street to the river's edge will be improved by elimination of the Causeway Street off-ramps.

The alignment allows proposed MBTA Orange/Green Line public transportation improvements to take place, and they will be enhanced by the availability of a water transportation terminal proposed for Lovejoy Wharf as part of the project mitigation program. In addition, the revitalization of the area that will accompany the development of the new Boston Garden complex and other Bulfinch Triangle District projects will bring office workers to the waterfront for walking and jogging on weekdays as well as weekends. Removal of the existing overhead I-93 bridge and other parkland improvements at Paul Revere Landing Park, south bank, will enhance this resource.

Cambridge/Charlestown. The large highway viaduct structures connecting the Artery/Tunnel Project to the CANA project will physically dominate the area. Pedestrian connections between Paul Revere Landing Park and North Point in Cambridge will require special design to be safe for pedestrian use under and next to these viaducts. Paul Revere Landing Park (north bank) can be expanded further westward and pedestrian connections to North Station will be improved as a result of the project.

The Proposed Action will preclude landscaping some of the area under the CANA ramps that was required in the Chapter 91 Special Conditions for the CANA project; however, construction of the pedestrian bridge and walkway included in the Special Conditions can be accommodated, and will be even more enhanced by additional pedestrian improvements to be created through Artery/Tunnel Project summarized in Section 14.3.1 and detailed in the Section 4(f) Evaluation in Part III of the SEIS/R.

Shifting the bridges 500 feet to the west will have adverse land use impacts on the planned redevelopment opportunities in the North Point area, but will not affect any existing water-based recreation facilities or preclude the development of such facilities in the basin adjacent to the MDC Maintenance Facility.

A beneficial impact of the project is that the Department has the opportunity, in conjunction with other public agencies and private interest groups, to address the issues of access to and along the Lower Charles River in a comprehensive way through a public planning process. The Proposed Action will have some adverse land use and visual impacts associated with the highway structure but, without the project, the achievement of open space improvements and functional pedestrian linkages would occur in a more incremental fashion, over a longer time horizon, or not at all, constrained by public funding or redevelopment planning by the public and private sectors.

Public access along the waterfront will be substantially improved over the FEIS/R plan; there will be a vast improvement over the currently limited public access as well. Major improvements to the existing pedestrian connection between Boston and Charlestown and a new connection between Charlestown and Cambridge will be developed as mitigation measures of the project [see Part III, Section 4(f) Evaluation].

14.2.2 Fort Point Channel

14.2.2(a) Long-Term Impacts

The components of the Proposed Action that could generate long-term impacts in this area are:

- Fort Point Channel tunnel box
- new Frontage Road and seawall
- I-90 and other approach ramps
- ventilation building 1
- ventilation building 3
- new Fort Point Channel seawall and fill
- permanent Dorchester Avenue bridge
- Wye Connector
- Broadway bridge
- railroad bridge
- Gillette cooling loop modification

The proposed project plan has been developed after a review of the FEIS/R plan and the consideration of numerous alternative plans which sought to accomplish the important functions of providing a connection between I-90 and South Boston, maintaining access along existing local streets and bridges, and maintaining existing rail service in the area. The proposed plan accomplishes these goals with substantially less impact on the waterway than in the FEIS/R plan. This is because the new design places the I-93 northbound lane inland, rather than in the Fort Point Channel. However, there remain unavoidable impacts from the tunnel crossing of the Channel and the reconfiguration of Frontage Road, Dorchester Avenue, Broadway, and railroad bridge crossings.

14.2.2(b) Wetland Resource Impacts

Water circulation and distribution of sediment grain size will be locally affected by the proposed Fort Point Channel tunnel box as part of the Proposed Action. As described in Chapter 13, the tunnel box will create increased water velocities elsewhere. The resulting change in grain size will not, however, change the existing benthic community which is dominated by pollutant-tolerant worms.

The change in water circulation will affect the Gillette water cooling system. (Details on this and impacts to water quality parameters also are provided in Chapter 13.) The associated changes in water circulation and sediment regime and water quality parameters will not adversely affect the existing wildlife and fisheries habitat since they are already substantially degraded. Further, the recolonization of the tunnel roof by the adjacent benthic community will maintain the existing wildlife and fisheries habitat. There is no designated fish run in the Channel.

The tidal mudflats, which will be lost as a result of the fill, have a low functional importance for flood control, storm damage prevention, and fisheries and wildlife habitats. Some reduction in sediment and nutrient retention may occur. However, the overall decrease is unlikely to substantially impair this value due to the small size of the area involved, as can be seen from Table 14.6. The bulkheads which will replace them will be high enough to control flooding and prevent storm damage. The stability of the resource area is not expected to be adversely affected.

The loss of the coastal wetlands could not be avoided due to its proximity to the roadway connections and the turning movements that must be accommodated. (All of the other design options would result in the total loss of these resource areas. The Proposed Action incurs the least long-term impacts of all the design options considered because the northbound lanes of I-93 are to be located under Atlantic Avenue, rather than follow the long axis of Fort Point Channel. See Part II C for brief descriptions of design options considered in this area.)

However, the small size (0.06 acre) of the coastal wetland severely restricts the range of functions and the value it performs. (It has a low value rating. See Table 3.18 of the 404(b)(1) Guidelines.) The loss of this wetland will have minimal effect in the South Bay.

14.2.2(c) Waterways/Flowed Tidelands Impacts

Of all the activities proposed to take place in the Channel, placement of the Fort Point Channel tunnel (I-90) will have the most impact. The tunnel box will occupy approximately 94,400 cubic yards of the water body. It has, however, been designed to minimize fill to the greatest extent possible. This is not a substantial volume loss of flood control capacity and will not degrade the ability of this resource area to perform its functions of flood control and storm damage prevention. (Chapter 15, on floodplains, provides more detail on this.)

The bottom topography of the Channel will be modified due to the placement of the top of the tunnel. Sediments along a portion of the tunnel alignment will be replaced with the precast concrete top of the tunnel at an elevation approximately 6 to 9 feet above the existing mud line.

The I-90 tunnel and associated approach ramps, and the placement of ventilation building 1, will require the filling of about 3.1 acres of the non-navigable portion of Fort Point Channel, extending up to approximately 20 feet past the existing Dorchester Avenue bridge into designated navigable waters. (It is proposed to relocate the bridge 20 feet further downstream. The new bridge then will extend from the edge of the new seawall to the shore across in a double span with a 4-foot-wide pier placed in the water.) This will involve the reinstatement and reconstruction of the seawall and bulkheads, extending from 30 feet to 200 feet outboard of the existing shoreline. The fill material will consist of contaminant-free clean earth and gravel alongside the tunnel and ramps. Approximately 112,200 cubic yards of water body will be lost. It is not expected that this will be a substantial impairment of flood control capacity (see Chapter 15).

It is anticipated that the reduced flow area resulting from the proposed fill will cause increased flow velocities. A hydraulic analysis was performed using the HEC-2 model (Water Surface Profiles, August 1979, USACE). The results of the analysis indicate that in the event of a 100-year flood the flow velocity at the narrowest constriction (around Dorchester Avenue bridge) would increase from 2.0 feet per second (fps) under the existing condition to 6.15 fps under the proposed long-term condition. This substantial change in flow velocities will require protection such as riprap or gabion to prevent scouring, even though the 100-year event is rare.

As part of the project, approximately 800 piles, derelict piers, and other structures in over 4.5 acres of Fort Point Channel will be removed. These derelict structures are currently a hazard to navigation and restrict the utility of the waterway for recreational use. The removal of derelict piers and piles will result in improving the quality of the existing watersheet and potential access to the water.

The Wye Connector, Broadway bridge, and the railroad bridge will not have any long-term impacts on the Channel. The bridges will be either removed and replaced, or partly restructured, in order to facilitate the construction of the I-90 tunnel and associated ramps. The number of piers that will be placed into the waters of the Channel are fewer than those existing. The new piers will be constructed of steel.

Fort Point Channel is navigable except for the portion upstream of the Dorchester Avenue bridge. The Fort Point Channel tunnel box will decrease the controlling depth of the waterway between the tunnel and the Dorchester Avenue bridge to approximately 11 feet at mean low water. However, the Channel now is used only for recreational boating and this change would have no impact on the waterway's utility for current or future recreational traffic. The top of the tunnel, including the stone armoring, will stand at elevation 84. Mean sea level is defined at elevation 100 so that mean low water is at elevation 95; thus there will be 11 feet of depth with the tunnel box in place which is ample for recreational navigation. In addition, no vessel of sufficient draft or size that can pose an anchor dragging or sunken load hazard to the tunnel can pass through the existing brides closer to the mouth of the Channel due to their limiting horizontal and vertical clearances. The controlling depth of this waterway is 11 feet at the mouth of the Channel to Northern Avenue bridge; the bridge has a swing span with a 7-foot vertical clearance and a 75-foot horizontal clearance. Further up the Channel, the Congress Street bridge has a bascule span with 6-foot vertical clearance and a 75-foot horizontal clearance (maintained closed), while the Summer Street bridge has a retractable span with 4-foot clearance and a 51-foot horizontal clearance (maintained closed).

Because Fort Point Channel does not support any commercial fishing or shellfishing activities, the Proposed Action will have no impact on this interest. Recreational fishing from the Northern Avenue and Congress Street bridges will not be affected by the project.

The proposed tunnel and fill to be placed along Fort Point Channel will not preclude the future operation of water transportation in the Channel. Existing water transportation opportunities in the Channel are limited by navigational constraints posed by low clearances on existing bridges. With the new Northern Avenue bridge in place, the practical limit of water transportation activity will shift to the Congress Street bridge. (Impacts and mitigation caused by the overall project on Water Transportation is described in Chapter 3, Transportation.)

14.2.2(d) Waterfront/Filled Tidelands Impacts

One of the main benefits of the project will be improved highway access to water-dependent users located in South Boston. South Boston is home to the largest concentration of marine industries in Boston Harbor, including seafood processing, fishing, passenger vessels, bulk cargos, auto imports, container terminals, oil storage and other uses. Each of these to be successful requires good vehicular access from the regional highway network to the waterfront. This portion of the project will benefit the entire South Boston marine industrial sector due to the improved access to the waterfront.

The City of Boston views additional investment in improved truck and railroad facilities as a prerequisite for expansion of the working waterfront and as the base for a transportation network that will restore the area as a center of economic growth. The provision of a direct connection between the area's industries and Logan Airport, and direct access by the

Seaport Access Road to and from links in the regional highway network, is included as a major goal in the Fort Point Channel Plan. The Plan states that the lack of such a direct access to the airport "has been an impediment for businesses in the area."

Project activities which will impact the waterfront and filled tidelands in the vicinity of Fort Point Channel include the construction of the bridge approaches and roadways, a relocated cooling water intake, ventilation buildings 1 and 3, the barge loading facility at the Boston Edison site, the 12-acre temporary casting basin, and various utility relocations.

The project will relocate the cooling water intake structure for the Gillette Manufacturing plant, a water-dependent industrial facility. However, the relocation will not cause any adverse impact on the operation of the facility.

The 12-acre casting basin will be excavated from land adjacent to Fort Point Channel where the proposed pre-cast segments of the immersed tube Fort Point Channel tunnel will be built. The casting basin is proposed on land which is not in water-dependent use but is used for parking. The Seaport Access Road tunnel will be constructed within the excavated area and the land surface will be regraded.

The construction of the roads and bridges, ventilation building 1, and the placement of fill in Fort Point Channel will increase opportunities for public access along this portion of the Channel. While some restrictions on public access will be necessary in the interest of public safety, there will be improved public access along Dorchester Avenue and along the edge of the Channel.

Opportunities for upgraded public access to Fort Point Channel will be created by the construction of ventilation building 1 and ventilation building 3. These sites will be designed to provide access to and along the water's edge in locations where access does not currently exist.

Visual access to the water will be affected by the construction of the two ventilation buildings proposed along Fort Point Channel. Ventilation building 3, to be placed along the west bank of Fort Point Channel at the Boston Edison substation site, could take advantage of the existing setting and provide views from the surface roads into the Channel (see Chapter 9, Views, and Figure 9.23). Public access to the waterfront will be provided along this site (see Chapter 8). Pedestrian views of the stacks could be shielded from view by constructing a building around the stacks. Views of Fort Point Channel upriver of the Dorchester Avenue bridge will be improved through the removal of 800 derelict piers and piles.

(Table 14.11 summarizes the long-term and short-term impacts in the Channel.)

14.2.3 Boston Inner Harbor

14.2.3(a) Long-Term Impacts

The activities in this area that could incur long-term impacts are:

- o Third Harbor Tunnel
- o seawall reconfiguration and fill

Table 14.11

PROPONENT'S FACTUAL DETERMINATION: FORT POINT CHANNEL

	Short-Term	Long-Term
Substrate	Disturbance and agitation	Direct loss of about 8.39 acres of substrate. Top of the south seaport access tunnel must extend above mudline to clear the MBTA Red Line. About 4 acres of fill for relocated roadway and ventilation building is necessary.
Water Circulation	Change in circulation pattern and flow rate will result from about 4 acres of fill along the west side of the Channel and south of the crossing as well from the protrusion of the tunnel box 7 feet above the mudline. Modeling indicates no substantial change in scour. A raw water intake will be relocated downstream from the proposed crossing. Modeling indicates no adverse effects. Project will change the shape of plume from thermal discharge but will not cause elevated temperature. Sediments will accumulate on the south side of the tunnel box, requiring periodic dredging to maintain the efficiency of the discharge. Operation of a fabrication site for immersed tube sections (casting basin) will change the current pattern as it is filled with water in preparation of floating sections into place.	The short-term changes in circulation pattern and flow rate occur from the cofferdam for the fill and temporary roadway and other facilities during construction. These continue when permanent features are installed.

Table 14.11 (Cont.)

PROPONENT'S FACTUAL DETERMINATION: FORT POINT CHANNEL

	Short-Term	Long-Term
Suspended Particulates	Suspended solids will increase during dredging and filling. Contamination in the sediments may increase metals concentrations in water. Silt fences, sediment traps and other techniques will be used to control turbidity.	Increases in suspended solids will be associated with dredging to maintain effluent flow from thermal discharge. Concentrations will be of short duration since flushing is not impaired. Otherwise, no change from present conditions.
Contaminants	The potential exists for some increase in contamination from dredging existing sediments, but it is unlikely to be severe because EP Toxicity Tests indicate levels are well below the hazardous waste threshold. Contaminants in casting basin will be controlled so that they will not be released to the environment when immersed tube sections are floated into place.	No change from present.
Ecosystem	Reduction in open-water feeding area for birds.	Net loss of aquatic environment for fish along the edge of the Channel and from the tunnel box. Benthic macroinvertebrate population may increase because tunnel will be backfilled with clean fill.
Mixing Zone	Dredging tunnel trench, filling cofferdam cells, discharging water from within cofferdam and casting basin, are activities which involve dissemination of suspended solids. These activities will be infrequent and of relatively short duration. Silt fences, sediment traps and similar techniques will help to confine the highest turbidity increases to the area closest to the discharge point.	Periodic dredging to maintain efficiency of thermal discharge.

Table 14.11 (Cont.)

PROPONENT'S FACTUAL DETERMINATION: FORT POINT CHANNEL

	Short-Term	Long-Term
Cumulative		The potential that the Roxbury Canal Conduit, a combined sewer outfall discharging upstream of the project, a thermal discharge from the Gillette Company, and restrictions in the Channel cross section (bottom profile and laterally) may have a cumulative adverse effect on water quality has been examined. Modeling indicates that no cumulative effect resulting from the interaction of these factors will occur.
Secondary Impacts		Construction of a tunnel under Fort Point channel as part of the seaport access highway will improve access to the South Boston designated port area.

Source: Bechtel/Parsons Brinckerhoff

The Third Harbor Tunnel is designed to improve access to Logan International Airport and upgrade overall travel efficiency in the Boston areas. The tunnel will be placed below the Harbor bottom from South Boston to Logan Airport, cutting through a corner of the slip east of the General Ship dry dock. This will be accomplished by excavation, placement of immersed tunnel sections, and backfilling with rock. (These construction phase impacts are discussed in further detail in Chapter 20.)

14.2.3(b) Wetland Resource Impacts

Sediments along the tunnel alignment in Boston Inner Harbor will be replaced with clean rock fill at approximately the same elevation as currently exists along the south edge of the cut, but lower along the north side of the cut, at a varying depth of 0 to at most 10 feet below the mud line.

The bottom topography of the Harbor will not change substantially since the tunnel will be below the existing Harbor floor. Backfill will be placed so that the bottom topography is similar to existing bathymetry on the south side such that no storm damage or erosion of coastal resources will occur as a result of this project. Sedimentation and siltation will fill back over the north side of the tunnel with time. Backfilling with the dredged material will cause turbidity and require more construction time in the Harbor.

Alterations in water circulation patterns and distribution of sediment grain size will be minimal in Boston Inner Harbor, as indicated by the discussion of tidal prisms in Chapter 13 and 20. What changes will occur will be small enough as to have no impact to any existing fisheries or wildlife habitats. The placement of clean gravel-sized backfill over the tunnel will provide new substrate for colonization by the existing benthic community.

One of the impacts that will result from the construction of the Third Harbor Tunnel will be disturbance to the existing riprap bank at the Bird Island Flats end of the tunnel as well as of the riprap and steel sheet bank between the Subaru Terminal and the General Ship dry dock. The existing revetment near General Ship will be affected by the placement of the tunnel which will cut through a corner of the revetment; this will require filling resulting in a slight seaward displacement of the sloped revetment. The rock fill will permanently displace 0.7 acre (3,145 square feet) of the resource area, resulting in no measurable impact to the flood storage capacity of the Harbor. The tidal water will not lose any of its functions, nor will its value be impaired. The riprap in these areas will be reinstated.

Because there are no long-term changes to the bottom topography or channel capacity, the Harbor's ability to perform its significant role of providing storm damage prevention and flood storage capacity will not be affected. While the Third Harbor Tunnel will stimulate economic development (see Chapter 7), it will not specifically promote growth and development in damage-prone or buffer areas within the 100-year coastal floodplain.

There is an annual migration through the Harbor of such anadromous fish as alewife, smelt, and manhaden. Although not an anadromous fish, per se, winter flounder enter the Harbor in late winter and early spring to spawn. Fish passage will not be obstructed by the presence of the tunnel after construction. There also will be no change to the volume and rate of flow of water, nor to water patterns and circulation within the fish run as a result of the project because the tunnel will be well below the Harbor bottom. (Construction impacts of dredging and blasting on water quality, circulation, and marine life are discussed in detail in Chapter 20.)

The project will not affect municipal or private water supplies, although some utilities will be relocated.

14.2.3(c) Waterways/Flowed Tidelands Impacts

All waters of the Harbor, except the waters on the west side of the Inner Harbor adjacent to the South Boston and Central areas, are officially navigable. Since the tunnel will be below the Harbor bottom (see Figure 14.12), there will be no long-term navigation impact on the Inner Harbor. The quantity of fill near General Ship will be insignificant.

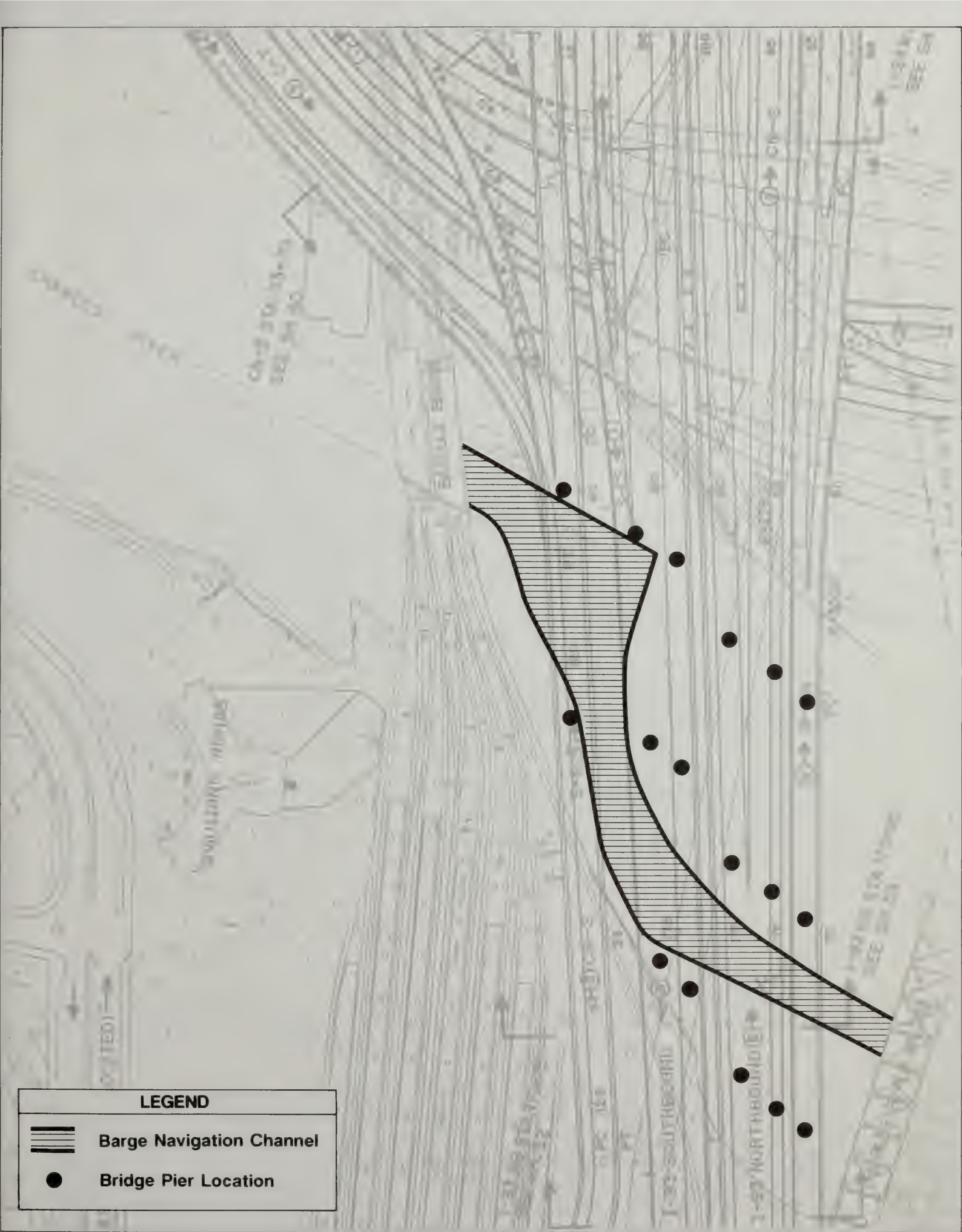
The tunnel has been designated to allow for the deepening of the entire main shipping channel to 40 feet below mean low water. At the present time, one-half of the channel is at 35 feet and one-half at 40 feet. The tunnel would, however, preclude deepening either channel to more than 40 feet. The Department has informed Massport, the Massachusetts Department of Environmental Management, and USACE in writing of the 40-foot depth restriction that the Third Harbor Tunnel would impose on any future dredging projects. These agencies have responded that the proposed project depths are sufficient to meet their needs. Although some large vessels do require depths greater than 40 feet, the existing Sumner/Callahan and Blue Line tunnels already preclude dredging deeper channels into the Chelsea Creek and Mystic River areas for such larger vessels. The constraints imposed by the Third Harbor Tunnel will limit future dredging to accommodate larger vessels at piers located between General Ship and Commonwealth Pier on the South Boston side and at Massport Piers 1 through 5 and the Boston Marine Works in East Boston. Future dredging projects on the Outer Harbor side of the new tunnel would not be affected in any way by the Artery/Tunnel Project, and facilities for vessels drawing over 40 feet could be developed at the Reserve Channel, the Conley Terminal, and Massport Marine Terminals. The few, if any, economic implications of the 40-foot depth constriction on future deepwater port activities are discussed in Chapter 7.

The construction of the tunnel may have short-term impacts on the lobster fishery by precluding the setting of pots along the shoreline in the vicinity of the tunnel project. The impact will be of short duration and will not result in in permanent impact on the lobster resource or the fishery.

14.2.3(d) Waterfront/Filled Tidelands Impacts

Construction of the Third Harbor Tunnel will improve access to the Designated Port Area in South Boston for maritime industries. Improved vehicular access to the regional highway network will assist in the long-term viability of maritime industries located in the Designated Port Area. Many of the seafood processing firms located in South Boston also rely on air freight for both the receipt and shipment of perishable seafood products. Direct reliable access to Logan Airport will assist in meeting the time-sensitive nature of these perishable cargoes.

Placement of the ventilation building at the Subaru Terminal will, however, result in the loss of 0.7 acre of wharf area (currently used to store automobiles prior to delivery to dealers throughout New England and New York) within the Designated Port Area. In light of the size of the existing terminal, this slight reduction in area will not significantly



FIGURE

14.12 Barge Navigational Channel Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

affect the utility of the facility for the receipt, storage, and distribution of automobiles.

The proposed ventilation building 6 will, however, open up the opportunity for public access to the waterfront in this active Designated Port Area. Due to the security limitation at both General Ship and Subaru, the public does not presently have access to the Harbor in this vicinity. The new ventilation structure will provide public access in this area and allow the public a close-up view of the operations of General Ship and the Subaru Terminal, as well as the overall view of Harbor activities. This location is special in that it is rare for the public to have the opportunity to view these maritime industries at close range. The project will not affect any existing public access in East Boston.

The construction of a temporary construction road and staging area near Fid Kennedy Avenue will temporarily utilize filled tideland. The construction of the Seaport Access Road and Third Harbor Tunnel will provide the transportation infrastructure to support the maritime-industrial economy of the South Boston area.

The barge loading facility at Dry Dock #3 will temporarily utilize this facility for the transportation of materials, a water-dependent use consistent with the area's Designated Port status. The dry dock is not presently in use.

The project also will require the relocation of the loading dock at Nagle Seafood, a seafood processing firm. This action will be implemented without disrupting operations of this industry.

The construction of the tunnel will require the relocation of the General Ship Corporation steam plant. This relocation is proposed in an area adjacent to the existing plant and will not significantly disrupt this existing water dependent use.

Impacts from temporary turbidity in seawater should not impact the industrial seawater users in the vicinity, including General Ship and lobster wholesalers at Pier 7. Measures will be taken to coordinate construction activities to avoid adverse impacts to these users.

(Table 14.12 summarizes both the long-term and short-term impacts to Boston Inner Harbor.)

14.3 MITIGATION

Project implementation will result in the direct loss of both inland and coastal resource areas and will utilize both flowed and filled tidelands. State and Federal regulations and policies require that measures be taken to mitigate any adverse impacts.

Measures to mitigate tidelands impacts include design modifications undertaken to protect existing maritime users, provision of extensive public access and public open space wherever feasible as part of the design, development of an overall operations plan for navigation-related impacts of the project, improved transportation access for maritime industries, and removal of derelict piers and pilings. Wetlands replacement and landscaping with appropriate mixture of wetlands and other plant species suitable for the growing conditions will be undertaken at the Millers River as mitigation measures.

Table 14.12

PROPONENT'S FACTUAL DETERMINATION: BOSTON INNER HARBOR

	Short-Term	Long-Term
Substrate	Temporary disturbance of about 13.5 acres of Harbor bottom for dredging.	Backfill will be uncontaminated, fill the trench to the approximate elevation of the existing Harbor bottom and will be of a similar character.
Water Circulation	No change	No change from present condition.
Suspended Particulates	Use of silt curtains and other techniques will contain highest levels of suspended particulates to the vicinity of the dredging operation.	No change from present condition.
Contaminants	None expected to be released so no change during construction.	No change from present condition.
Ecosystem	Cessation of dredging between 15 March and 15 May will protect winter flounder populations.	No change from present condition.
Mixing Zone	Much of the discharge of backfill on the tunnel will consist of coarse material. Increased levels of suspended solids will be contained in the vicinity of the work area.	No change from present condition.
Cumulative	None expected	None
Secondary Impacts	None	Improved access to Logan Airport.

Source: Bechtel/Parsons Brinckerhoff

Specific mitigation measures are recommended in the Area North of Causeway Street, however, due to adverse impacts of the Proposed Action structures to public interest in tidelands. These measures are highlighted here. (For further details, see the Section 4(f) Evaluation in Part III of the SEIS/R).

The south bank portion of the Paul Revere Landing Park not permanently used by the Proposed Action will be restored after construction. The reconfiguration that will occur in this area will maintain previous park functions and enhance them, as 73 parking spaces will be displaced. On the north bank, the park will be expanded north and west to the CANA ramps and new bridges, and replanted as a major element in the riverfront park system, connected by landscaped walkways through the Chapter 91 area and to Charlestown.

An attractive pedestrian environment will be developed on the east and north sides of the Charles River bridge transition section and abutment between Paul Revere Landing Park (south bank) and Causeway Street. Access on the west side of the bridge abutment will be determined in coordination with developers of the new Boston Garden.

A small urban plaza marking the entrance to Paul Revere Landing Park will be constructed as a part of the Proposed Action above the Causeway Street portal of the Central Artery tunnel.

A pedestrian walkway and a commuter ferry landing facility will be constructed on Lovejoy Wharf.

The Department will pay for the preparation of an overall master plan and design and contract documents for two major developments essential to the completion of the MDC park system and for the park development of these properties. These are: (1) the Nashua Street parkland which provides a major opportunity for heavy public use of an extended Esplanade; and (2) the former GSA site, which will be major park node on the north bank of the river serving new development in Cambridge and connecting to Paul Revere Landing Park via the improvements in the CANA project Chapter 91 area. Land or easements along the North Point development area, which completes the connection on the north side of the river, may be obtained through the development process, and the Department will provide assistance with park improvements on easements secured by the MDC (see Figure 8.19).

Improvements to Leverett Circle will be provided as a part of the Proposed Action, including landscaping of a larger reconfigured parkland area as well as reconstruction of pedestrian overpasses. Landscaping in the area will be compatible with the Charles River Esplanade ambience and will create an attractive visual terminus to Storrow Drive.

14.4 COMPARISON WITH FEIS/R

Since the publication of the FEIS/R, there have been substantial reductions in the proposed amount of encroachment on wetlands, waterways, and coastal zones (see Figures 14.13 through 14.15). The northbound Central Artery has been removed from Fort Point Channel, and the I-93/I-90 Interchange has been moved westerly with most of it onshore. Consequently, the total filling of Upper Fort Point Channel for the I-93/I-90 interchange has been reduced by 76 percent, from 13 acres to 3.1 acres, or 440,440 cubic yards to 112,200 cubic yards, a reduction of 74.5 percent in volume. The tunnel box in Fort Point Channel will encroach upon 5.25 acres of resource area or 94,400 cubic yards of the water body, which represents a 33 percent reduction in area and a 46 percent reduction in volume when compared to the encroachment imposed by the 1985 proposal. Overall, the Proposed Action will result in a 60 percent reduction in encroached area and a 66 percent reduction in volume displaced compared to the FEIS/R scheme.

In addition, the removal of the Leverett Circle connector from the Charles River, as proposed in the FEIS/R, will result in a 96 percent reduction in volume of encroachment and 87 percent reduction in area at that location. The 1985 proposal required 12,000 cubic yards of water displacement, while the Proposed Action requires only a net fill of 50 cubic yards, or an equivalent of 0.44 acre down to 0.057 acre of land under water, inland banks, and bordering vegetated wetlands.

Neither the fill in the slip east of the General Ship dry dock in Boston Inner Harbor no the bridge piers in Millers River was a part of the FEIS/R. The fill at General Ship will be minor and will have no long-term impact on the environment. Several areas adjacent to the project have been studied as possible Millers River relocation sites. Wetlands replacement and landscaping as appropriate will be undertaken when a final site is selected.

14.5 RESOLUTION OF MAJOR ISSUES RAISED BY PUBLIC AGENCIES

The major issues raised in the agency review were as follows. The chapter lacked sufficient data and analyses, namely:

- o Section 404(b)(1) analysis - USACE
- o cumulative impacts
- o alternative analysis, especially for the Area North of Causeway Street
- o hydraulic studies
- o tidelands impacts

These issues were resolved in the following manner:

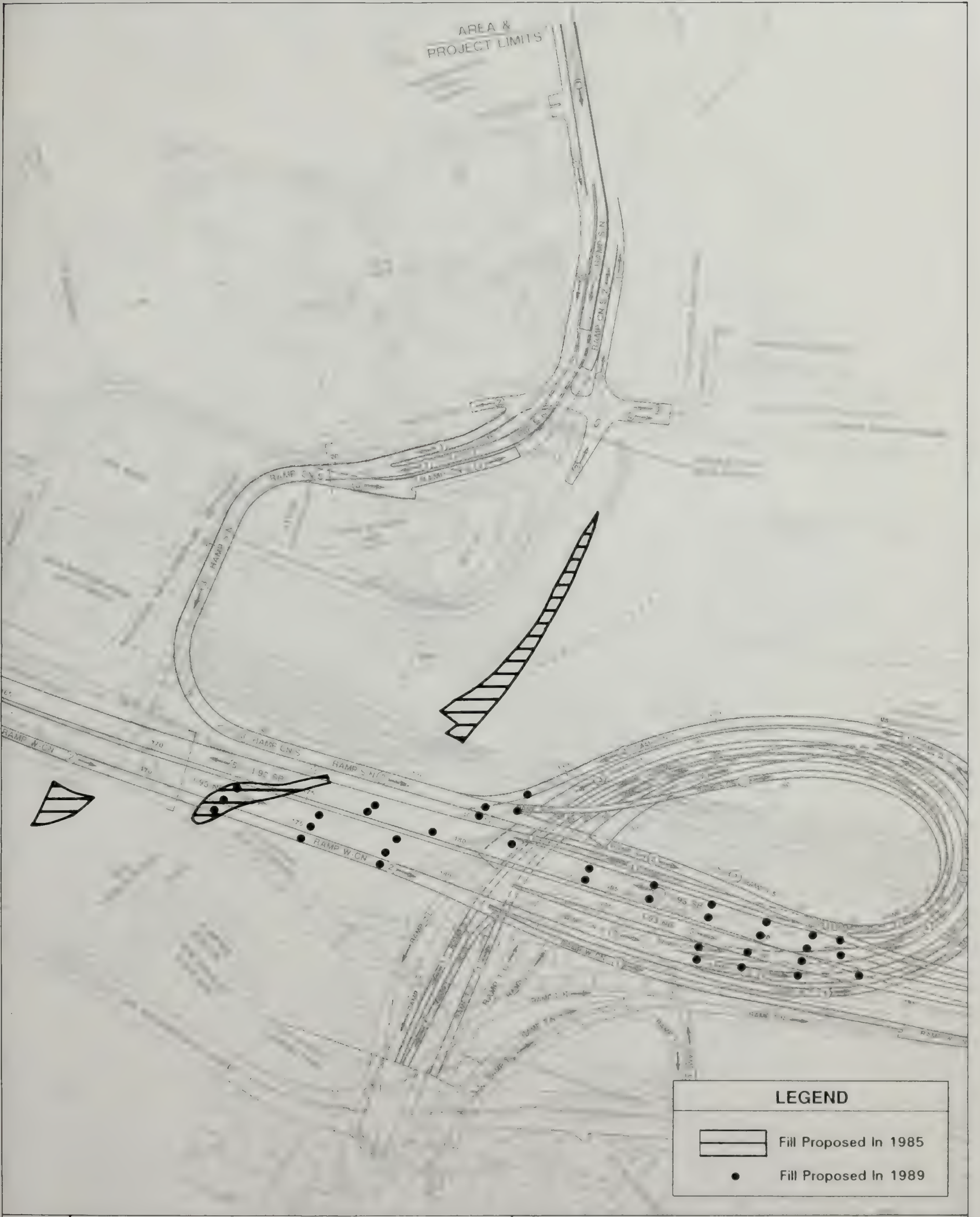
- o The Section 404(b)(1) analysis was prepared [see Section 404(b)(1) Appendix].

- o The overall impacts of the Artery/Tunnel Project and other concurrent major projects is discussed in Chapter 18.

- o A chapter was added that describes the alternative schemes studied in the Area North of Causeway Street in Part II of the SEIS/R.

- o A hydraulic study for Fort Point Channel was conducted and is documented in Chapter 15.

- o Extensive treatment of tidelands-related issues has been incorporated into this section.



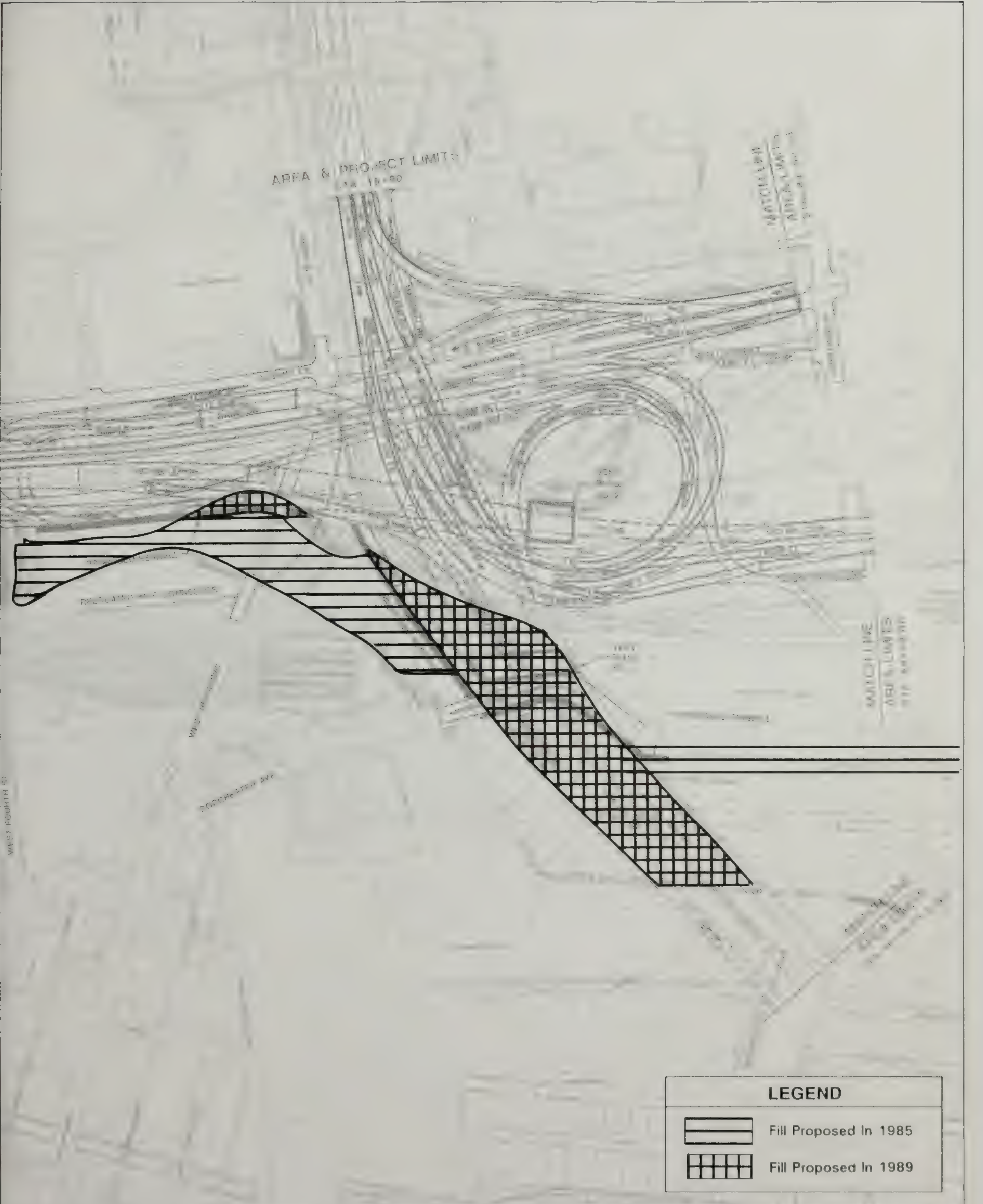
FIGURE

14.13

Charles And Millers River Fill: 1985 vs. 1989

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
Feet



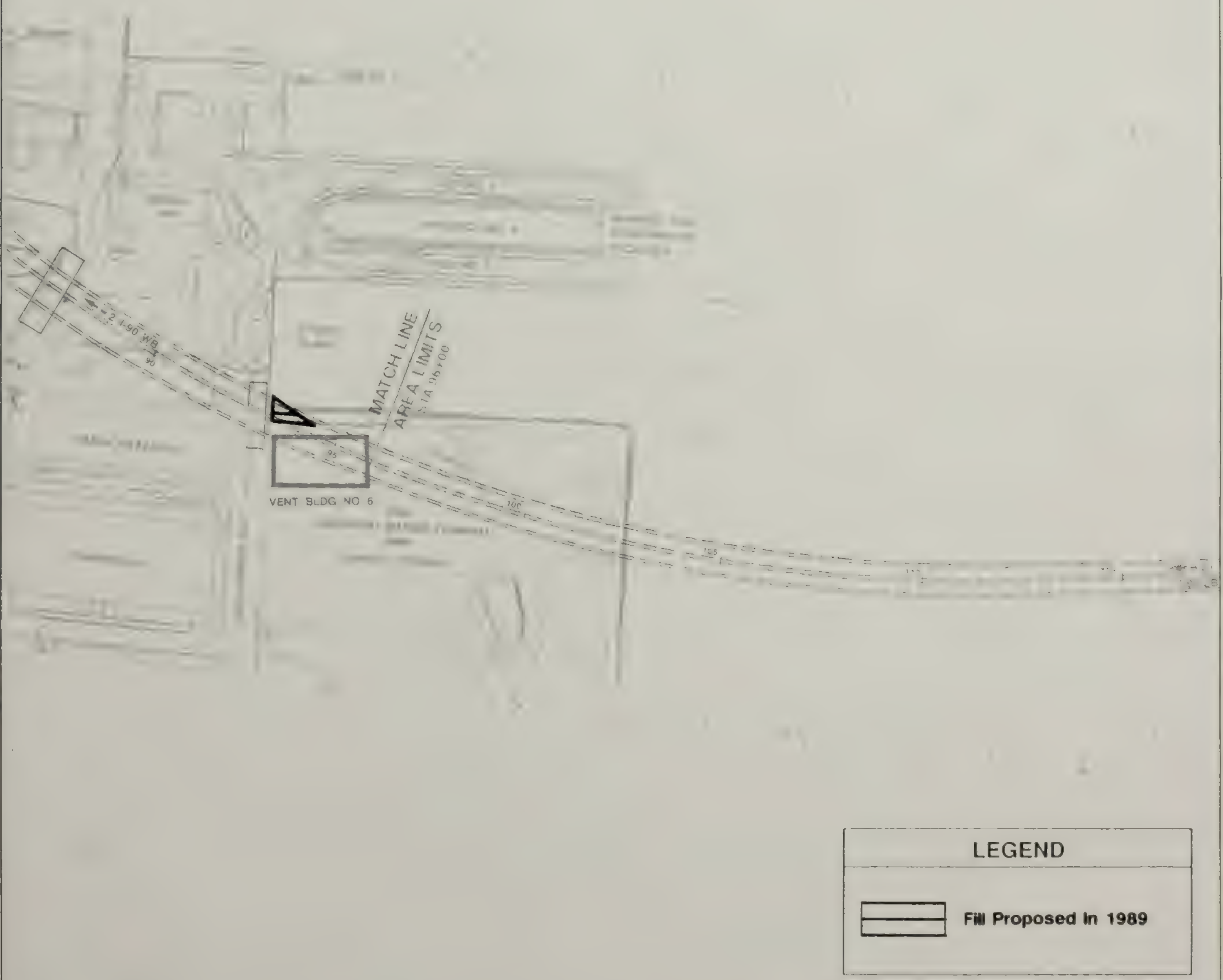
FIGURE

14.14

Fort Point Channel Fill: 1985 vs. 1989

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800 Feet



FIGURE

14.15 **Boston Inner Harbor Fill: 1985 vs. 1989**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800 Feet

Chapter 15 – Floodplains

Chapter 15

FLOODPLAINS

The following sections describe and assess the impacts of the Proposed Action on floodplains. According to the Federal Emergency Management Agency (FEMA), the 100-year flood event is a flood with a 1 percent chance of being equaled or exceeded during any year. Hydrologic analyses are carried out to establish the peak elevation of the 100 year flood, resulting in establishment of the linear extent of the 100-year floodplain. These sections cover only those impacts that occur on the mainland; potential impacts in offshore areas that could result from the materials disposal program are addressed in Chapter 20 and in Part II of the SEIS/R.

Section 15.2 describes potential floodplain impacts as a result of the project. Section 15.3 discusses possible mitigation measures, and Section 15.4 compares the amount of floodplain encroachment by the Proposed Action to that by the Preferred Alternative evaluated in the FEIS/R.

Design improvements to the project since the FEIS/R will result in a reduction in the amount of floodplain encroachment by 60 percent in total surface area and 66 percent in total water body volume. Reduction in water body (or flood storage capacity) impacts will specifically occur in Fort Point Channel (76 percent less) and in the Charles River by (86 percent less).

15.1 AFFECTED ENVIRONMENT

The global rise in sea level is the only aspect relating to floodplains that has changed since the FEIS/R. However, the relevance of such a sea level rise to a reexamination of existing conditions is minor.

15.2 ENVIRONMENTAL CONSEQUENCES

It is expected that there will be no measurable impacts to existing flood storage capacity. Floodplain encroachment will take place at two saltwater tidal locations, namely Fort Point Channel and the Boston Inner Harbor at the slip east of the General Ship dry dock in South Boston. In addition, floodplain encroachment will take place in two freshwater nontidal locations, the Lower Charles River and the Millers River (see Figure 15.1).

Although the northbound Central Artery lanes as proposed in the FEIS/R have been removed from Fort Point Channel, it is still necessary for the Seaport Access Road (I-90) to cross under the Channel. The top of the I-90 tunnel box in the Channel, including the stone armoring, will be 11 feet below mean low water, and will extend to a maximum of 9 feet above the existing mudline, thus having no impact on the floodplain.

The project will require filling 3.1 acres (112,200 cubic yards) in Upper Fort Point Channel (South Bay) for ramps and depressed roadway portions of the I-93/I-90 Interchange that lead into the Seaport Access Road Tunnel. Fill will begin from the Dorchester Avenue Bridge, tapering back to an area near Fourth Street, displacing non-navigable waters. The existing bulkheads will be moved outboard. The new bulkheads will be built higher than the mean high water of the 100-year floodplain elevation for flood control and storm damage prevention.

The 3.1 acres of total encroachment by the project in Fort Point Channel is less than .002 percent of the waterplane area of the Inner Harbor. Flood storage capacity is contained within the tidal prism, that is, between mean low water and the 100-year flood stage level. Since the tunnel box will be below mean low water it does not encroach upon the flood storage capacity of the resource area and is, therefore, not considered to have any impact on the floodplain. The size of the tunnel has, nevertheless, been minimized to the extent possible in the Proposed Action. Therefore, it is expected that the displacement of floodwaters from the encroached areas of Fort Point Channel to other areas of the Harbor will result in a no measurable increase in flood stage.

Within Boston Inner Harbor, floodplain encroachment will be negligible, that is, 0.007 acres (3,145 square feet), east of the General Ship dry dock (see Figure 15.1). This slight amount of floodwater displacement will result in no measurable impact.

Within the Lower Charles River Basin, there will be a very small net increase in floodplain encroachment. While, at most, 17 new piers will be constructed in the Charles River, six existing piers will be removed. This will result in an approximately 0.009-acre (400-square-foot) net encroachment on the floodplain. No change in flood stage will result from this small increase because the river level is controlled by the new Charles River dam spillways. Final designs may reduce the number of piers crossing the Charles River to the minimum number possible. The DEP, however, may require either compensatory storage by dredging a part of the shoreline or a variance. An alternatives analysis for the alignment is provided in Part II of the SEIS/R and in the 404(b)(1) guidelines appendix, which show that the Proposed Action is the least damaging alternative.

In the Millers River, eight new piers will be constructed, resulting in an encroachment of, at most, 3,200 square feet. This will not pose an impediment to stormwater flowage as the Millers River already is constricted by the two 84-inch diameter culverts at its mouth where it flows into the Charles River. These culverts will continue to be the bottleneck to flows in the Millers River if the Millers River is not relocated as part of the mitigation program. The Millers River flood stage also is controlled by the Charles River dam. A variance may be required from the DEP.

15.3 MITIGATION MEASURES

Due to the inconsequential amount of floodplain encroachment in Fort Point Channel and Boston Inner Harbor, measures are not required to mitigate floodplain impacts in any portion of the project alignment in these areas. There will be no alteration in the horizontal or vertical extent of flood levels, which will continue at their usual levels under maximum flows. For details, see the Water Quality appendix and Section 13.2.1(a). In the Charles River, loss of a small portion of flood storage may require either dredging to reclaim the loss or a variance from the DEP may have to be obtained.

In addition, there will be no flood danger to the tunnel structures as tunnel portals and tops of boat sections will be constructed at elevation 114 (which is 14 feet above mean sea

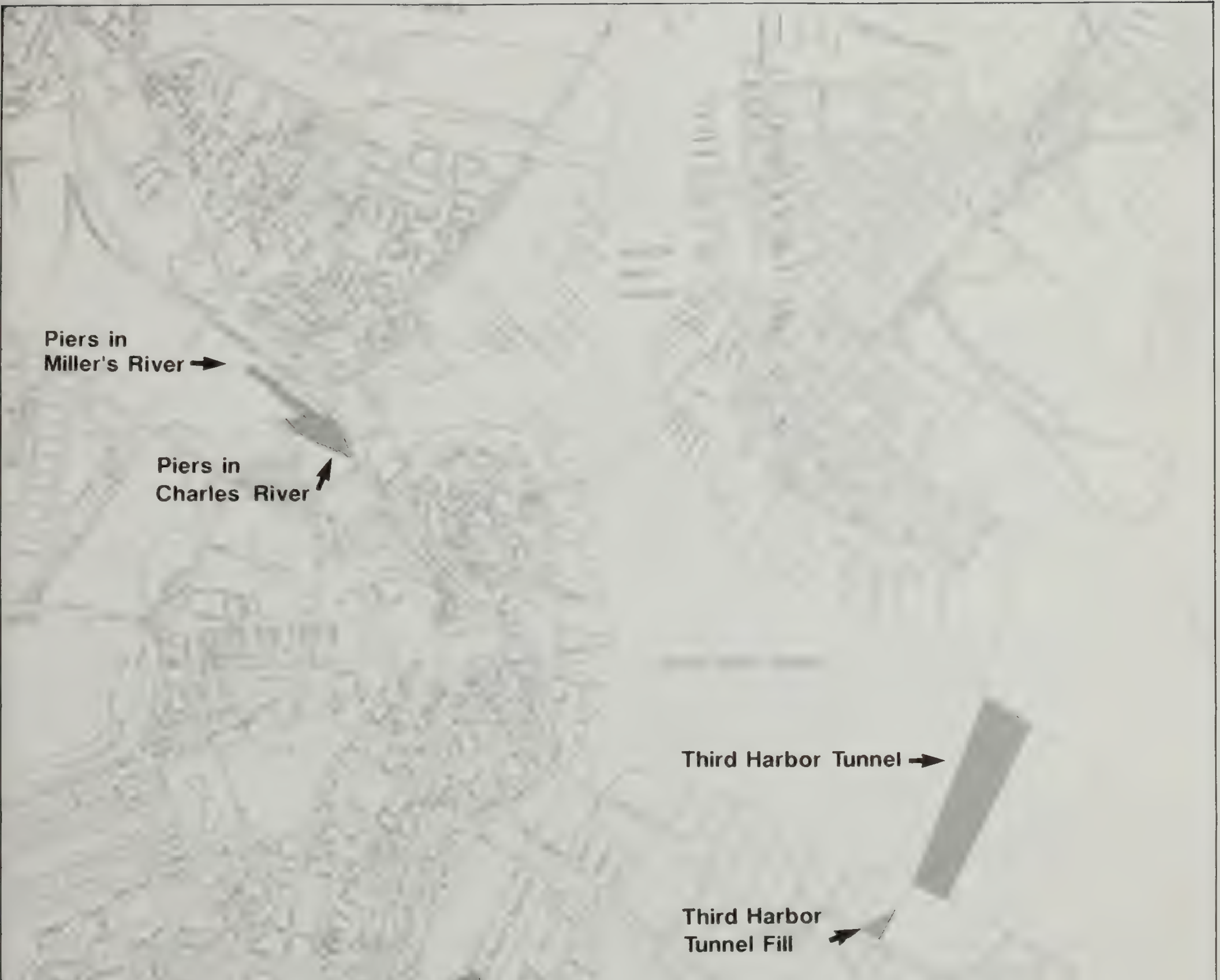


FIGURE 15.1 Locations Of Activities In The Water

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

level). This elevation allows for global sea level rise (.01 foot annually) and the added effect of a storm surge. The greatest recorded storm surge for the area was 5.7 feet above mean high water (10.4 feet above mean sea level) during the blizzard of February 7, 1978.

15.4 COMPARISON WITH FEIS/R

Since publication of the FEIS/R, there have been substantial reductions in the anticipated amount of floodplain encroachment due to the project. The previously proposed alignment of the northbound Central Artery in Fort Point Channel has been removed, and the I-93/I-90 Interchange has been moved onshore. Consequently, the total filling of Fort Point Channel has been reduced by 76 percent in area, from 13 acres to 3.1 acres, and by 74.5 percent in volume, from 440,440 cubic yards to 112,200 cubic yards. Although the Seaport Access Road tunnel box does not result in a loss of flood storage capacity, and thus does not encroach upon the floodplain area, its size has also been reduced to the greatest extent possible in the Proposed Action. The volume of the tunnel has been decreased by 46 percent.

In addition, the removal of the Leverett Circle connector ramp from the south bank of the Charles River as proposed in the FEIS/R will result in a 99.8 percent reduction in area of encroachment and 94.6 percent reduction in volume in the Charles River. The FEIS/R proposal would have resulted in the displacement of 12,000 cubic yards of water while the Proposed Action will result in the net displacement of only 14.8 cubic yards.

Neither the fill in the slip east of the General Ship dry dock in Boston Inner Harbor nor the piers in the Millers River were part of the FEIS/R Preferred Alternative. However, the fill in both these areas is insignificant in quantity in comparison to the entire body of water within the project limits.

The overall total quantity of fill will displace less than .002 percent of the entire floodplain area, that is, less than 3.611 acres of the Boston Inner Harbor that falls within the limits of the project. This will result in no measurable rise in sea level.

15.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

No major issues were raised in the Agency Review.

Chapter 16 – Vegetation and Wildlife

Chapter 16

VEGETATION AND WILDLIFE

This chapter summarizes the project's impacts on terrestrial vegetation and wildlife in the project area. Potential impacts on marine species are described in Chapter 13; construction period impacts from the offshore disposal of excavated and dredged material are addressed in Chapter 20 and Part II of the SEIS/R.

Section 16.3 describes the impacts that the project will have on terrestrial vegetation and wildlife; Section 16.4 discusses mitigation measures that may be necessary. Section 16.5 concludes by comparing the impacts that could result from the Proposed Action to impacts described in the FEIS/R.

16.1 AFFECTED ENVIRONMENT

The existing vegetation and wildlife conditions within the project area have not changed measurably since the FEIS/R. The only Federal or State endangered or threatened species found within the project limits is the peregrine falcon.

16.2 ENVIRONMENTAL CONSEQUENCES

Impacts to vegetation and wildlife habitat from work in the Artery/Tunnel Project right-of-way will be limited. Vegetation impacts will occur primarily in successional, abandoned areas which are sparsely vegetated and contain various amounts of refuse and debris. Impacts will consist of one or a combination of the following: (1) total displacement and replacement with concrete pavement; (2) disturbance, and/or (3) regrading and replanting. The impact areas include the abandoned railroad tracks near Fort Point Channel, turf occurring at Logan Airport, and vacant lots such as that adjacent to the Rapid Service Press building. Collectively, impacts to successional areas total approximately 2 to 3 acres, with the majority of these impacts occurring along Fort Point Channel in the vicinity of the Rapid Service Press building. The type of vegetational community to be affected is quite common to the Boston area. The project affects approximately 0.5 acre of landscaped parkland. [See the Section 4(f) Evaluation in Part III of the SEIS/R for impacts on parkland.]

The hunting grounds of peregrine falcons extend over miles of territory. Locally, their habitat is restricted to the high-rise buildings of downtown Boston. While peregrine falcons are known to frequent higher bridge structures in other cities, none have been reported in the structure of the Charles River high bridge, which will be removed as a result of the project. It is not anticipated that the Proposed Action will affect their local habitats.[1]

---

1. Brad Blodgett, State Ornithologist, Division of Fisheries and Wildlife, July 21, 1988

16.3 MITIGATION MEASURES

Because impacts will be insignificant, no mitigation measures directed specifically to adverse impacts on vegetation and wildlife are proposed. The project, will, however, have substantial open space benefits from the depression of the Central Artery. There will also be increased landscaping opportunities in the Lower Charles River area, in East Boston, and in the Fort Point Channel area.

16.4 COMPARISON WITH FEIS/R

Although the alignment of the Artery/Tunnel Project has been modified in some areas from that presented in the FEIS/R, the overall impacts to vegetation and wildlife have not changed due to the limited amount of vegetation and wildlife resources within the project alignment.

16.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

No major issues were raised by public agencies.

Chapter 17 – Soils and Geology

Chapter 17
SOILS AND GEOLOGY

This chapter discusses, in general terms, the engineering capabilities of soils and geology in the project right-of-way to support project structure foundations and construction activities. Environmental consequences and mitigation measures associated with soils are presented in Chapter 20, Summary of Construction Activities, and in Part II of the SEIS/R, Materials Disposal Program. The Supportive Engineering Report (an appendix) provides details on geotechnical issues for each project subarea.

17.1 AFFECTED ENVIRONMENT

Increased understanding of the soils and geology aspects of the project has been achieved since the FEIS/R. Over 2,000 existing boring logs have been collected, evaluated, and placed in a three-dimensional, relational data base. Additional field exploration included 170 borings along land portions of the alignment, and 40 borings at water locations (the Charles River, Fort Point Channel, and near Spectacle Island in Boston Harbor), along with associated field and laboratory testing. In addition, a geophysical testing program was conducted along the Third Harbor Tunnel alignment and around Spectacle Island. This additional information formed the basis of revised geologic profiles for the entire proposed alignment which, in turn, permitted updating assessments of design and construction issues as they relate to adverse soil and groundwater conditions.

The bulk of the Proposed Action will be located in tunnels, requiring excavation and dredging of approximately 13.2 million cubic yards of material which also require disposal. The soils immediately adjacent to the excavations (approximately 11.7 million cubic yards) will be supported by reinforced concrete walls which will also be designed to support the adjacent structures. Most of the excavations will be much deeper than the depth to groundwater. In order not to affect existing structures, groundwater inflow will have to be controlled to maintain existing levels. [See Section 13.2.3(b) for more information on groundwater.]

Information on site geology along the alignment of the Proposed Action has been derived from available boring information and publications on the geology of Boston. These sources reveal the following sequence of material from the ground surface downwards:

- miscellaneous fill
- organic deposit/harbor sediment
- marine deposit
- glacio-marine deposit
- fluvial/glacio-fluvial deposit
- glacial till deposit
- bedrock

The surficial deposits of the Boston Basin, particularly the widespread blue clay and organic deposits, are known for their poor engineering properties (i.e., compressibility and low shear strength). The organic deposits are typically shallow and must be removed prior to placement of foundations. The blue clay, however, because of its lateral extent and depth, has been subject to engineering analyses to determine its stability for construction activities. Excavations penetrating into the blue clay will be designed with stiff lateral soil supports, and adequate precautions will be taken against heave of the excavation base, particularly if sensitive structures are located nearby. Typically, structural foundations would pass through the clay strata to support on the stronger underlying till or bedrock. However, if clay is excavated deep enough, it is possible to "float" a structure within the clay strata, in the same manner in which boats float in water. Some of the deeper tunnel sections may require additional downward loads to overcome the buoyant forces.

The Third Harbor Tunnel will require underwater rock excavation as well as clay and till removal. This type of work, while difficult, is not unprecedented. Deep complex excavations will be required at two MBTA tunnels, the Red Line under Summer Street and the Orange and Green Lines at Haymarket. The I-93/I-90 Interchange area will require not only deep excavations, but extremely wide cuts that will call for challenging support systems.

In summary, the complex geological history of the Boston Basin has resulted in a wide range of soil properties which vary over short distances. The properties of the large quantities of soils to be excavated will influence the methods of their excavation and disposal, as well as the performance of existing and proposed structures in or close to the project.

17.2 ENVIRONMENTAL CONSEQUENCES

The nature and level of contamination of soils to be excavated, as well as the proposed disposal methods, are presented in Chapter 20 and in Part II of the SEIS/R.

17.3 MITIGATION MEASURES

Mitigation measures associated with soils impacts are discussed in the above referenced sections of the SEIS/R.

17.4 COMPARISON WITH FEIS/R

Soils and geology were not addressed in the FEIS/R.

17.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

There were no issues raised by public agencies.

Chapter 18 – Irreversible and Irretrievable Commitment of Resources

Chapter 18

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

18.1 INTRODUCTION

This chapter discusses in general terms the commitment of resources permanently expended and the relationship of the Proposed Action to other projects. Detailed discussions of specific types of long-range impacts are contained in Chapters 3 through 16 of this document; construction impacts are described in Chapter 20; and the impacts of the Materials Disposal Program alternatives analysis are discussed in Part II of the SEIS/R.

18.2 COMMITMENT OF RESOURCES

The Proposed Action will require certain irreversible and irretrievable commitments of resources. Irretrievable human and economic resources will be expended for the planning, design, construction, and operation of the highway improvements which constitute the Artery/Tunnel Project.

Approximately 69 acres of surface land will be permanently acquired for the Artery/Tunnel Project right-of-way. An additional 81 acres of permanent subsurface easements will be required. This amount of land does not include City of Boston streets, Department-owned properties, and the approximately 19 acres of land to be permanently acquired by the Department in advance for construction of the South Boston Haul Road. This land will constitute an irreversible commitment during the time period that the land is used for a highway facility. Currently, there is no reason to believe that this land could not be converted to another use or that such a conversion will ever be necessary or desirable.

The design of the project does not, however, preclude development of air rights above the project right-of-way in certain areas or of certain adjacent residual parcels created by the project design should such development be considered desirable by other interests. For example, approximately 27 acres of potentially developable land in air rights over the Central Artery tunnel and adjacent to the tunnel would be created by the project. Other air rights development may be possible over tunnels at Logan Airport and in South Boston. In addition, many parcels could be created for development adjacent to the project on residual parcels in the Central Area, the I-93/I-90 Interchange Area and in East Boston. At Spectacle Island in Boston Harbor, the existing 97-acre island is proposed to be expanded by project materials disposal operations and possibly made suitable for development as a park, as envisioned under the Boston Harbor Islands State Park Master Plan. Therefore, it is very likely that the total amount of land permanently acquired by the transportation project will be substantially offset by a greater amount of land created for potential development. (See the Joint Development Appendix for more information on possible parcelization created by the project.)

Construction of the Proposed Action will result in the consumption of tangible raw materials, including an estimated 245,000 tons of steel reinforcing bars, 3.8 million cubic yards of concrete sand and concrete coarse aggregate, 1.15 million tons of cement, and other natural resources. The concrete deck of the existing Central Artery could be removed in panels, rather than pulverized, and could be recycled depending on market demand for such materials at the time of demolition. The clay material excavated from the project is valuable for capping sanitary landfills in the Commonwealth, for example.

The Proposed Action will result in the displacement of approximately 8.7 acres of wetlands in the Charles and Millers Rivers, Upper Fort Point Channel, and Boston Inner Harbor. An additional wetland displacement of up to 136 acres could affect submerged lands surrounding Spectacle Island, which would be filled as a result of the Materials Disposal Program (see Part II of the SEIS/R). According to the results of analyses presented in detail in Chapters 13, 14, 15 and Part II of the SEIS/R, and not repeated here, the overall effect of these displacements on flooding, marine ecosystems, and water quality is expected to be minimal. The total area of encroachment by the Proposed Action on wetlands in the highway project right-of-way is reduced by 59 percent, as compared to the Preferred Alternative the FEIS/R.

The equivalent of approximately 13,296,307 million British thermal units (Btus) is estimated to be consumed during construction of the Artery/Tunnel Project, while approximately 2,297,000 million Btus is estimated to be consumed annually to operate the lighting, ventilation, and other systems required to support the operation of the project.

The three new bridges crossing the Charles River will increase the area of the riverbanks in permanent shadow. The affected areas include existing parkland on the south riverbank and future I-93/Route 1 interchange landscaping on the north riverbank [see Section 4(f) Evaluation, Parklands in Part III of the SEIS/R]. However, the commitment of these shadow impacts in this area will be offset by substantial parkland gains in several project areas. Parkland could be developed elsewhere in the Lower Charles River area, atop the depressed Central Artery, adjacent to the I-93/I-90 Interchange, near Chinatown, and in East Boston. Of major importance is the possible development of new parkland on Spectacle Island in Boston Harbor, the proposed site of the confined marine disposal operation required for the project.

In addition shadows in downtown Boston will be eliminated, City streets will be reconnected, and vistas will be reestablished as a result of the project, reversing prior commitment of these resources by the existing elevated Central Artery.

18.3 RELATIONSHIP TO OTHER PROJECTS

During construction of the Artery/Tunnel Project, there are other major projects that are underway or will be underway in the same geographic area and generally at the same time, which together are not expected to have a substantial adverse impact on the affected environment (see Table 18.1). The $6 billion Boston Harbor Cleanup Project by the Massachusetts Water Resources Authority is by far the largest of these other projects which includes construction of new sewage treatment facilities at Deer Island, a new cross-harbor sewage tunnel between Nut Island and South Boston and Deer Island and a new outfall tunnel from Deer Island to Massachusetts Bay. The result of this and MWRA's future combined sewer outfall program will facilitate substantial improvement of Boston Harbor water quality.

Table 18.1

RELATIONSHIP OF THE PROPOSED ACTION TO OTHER PROJECTS

Project	Pertinent Concern	Comment
Combined Sewer Outfall Project (MWRA)	Traffic and air quality	Coordination task force adjusted maintenance of traffic plans to avoid conflict in areas of overlap (e.g., Fort Point Channel).
	Materials Disposal	The CSO project will generate rock cuttings that appear marketable or usable as structural fill. Disposal in an upland or marine site is being considered but no specific plans have been proposed.
	Water Quality	Improvements in water quality are expected after the year 2000. The Artery/Tunnel Project will treat tunnel drainage before discharging; other studies to be consistent with the Harbor cleanup project are continuing.
Harbor Cleanup Project (MWRA)	Barge Traffic	The construction of the Deer Island wastewater treatment facilities is supported by barges to minimize vehicle impacts. The period of construction generally overlaps the Artery/Tunnel Project but coordination with navigation interests indicate the channels can easily accommodate projected vessel traffic and the additional combined barge traffic associated with the two projects.
	Materials Disposal	The outfall tunnel will be constructed by tunnel boring machines. It is planned to use rock cuttings for road-beds or other productive purpose. Cuttings must be disposed as they are

Table 18.1 (Cont.)

RELATIONSHIP OF THE PROPOSED ACTION TO OTHER PROJECTS

Project	Pertinent Concern	Comment
		generated (summer of 1991 through summer of 1993) because of limited surge capacity at Deer Island. The Artery/Tunnel Project may be able to use some or all of this material.
South Boston Piers/Fort Point Channel Transit Alternatives (MBTA)	Traffic and Air Quality	Potential concurrent construction along Atlantic Avenue has been closely coordinated to avoid conflicts and minimize motorist inconveniencies.
	Dredging	The segment under Fort Point Channel could be constructed during the mid-1990s, which would overlap with the Artery/Tunnel Project. Adverse effects on water quality can be controlled with curtains or other measures. Some increased flooding potential might occur from a 100-year storm event. The postponement of major private real estate development projects in South Boston suggests that associated dredging will not overlap thus eliminating the potential for coordination problems and water quality impacts.
	Materials Disposal	About 750,000 cubic years of material (29,000 cubic yards dredged) must be disposed. Upland and marine sites are being considered.

Table 18.1 (Cont.)

RELATIONSHIP OF THE PROPOSED ACTION TO OTHER PROJECTS

Project	Pertinent Concern	Comment
Parking Garage behind Boston Garden (MBTA)	Traffic and Air Quality	Street access for the parking garage construction force will be maintained during the 3-year construction period which will begin in early summer 1990.
	Materials Disposal	About 350,000 cubic yards of excavated material will be disposed as part of the construction contract, most likely at upland sites.
	Water Quality	Water pumped from the site will be passed through a sand drain or other treatment source as appropriate.

Source: Bechtel/Parsons Brinckerhoff

Neither project will impede efforts to accomplish the other and both project proponents are exploring ways to coordinate and build on each other's efforts.

In addition, the Department's current Central Artery North Area (CANA) Project, to be completed in 1992 will join the Artery/Tunnel Project in Charlestown and will greatly improve traffic operations in the I-93/Route 1 interchange area. The Artery/Tunnel Project will affect the design of the I-93/Route 1 interchange, but coordination of design has already occurred.

The Massachusetts Bay Transportation Authority continues to plan and build major improvements to the existing rapid transit, commuter rail and commuter boat systems in the project study area. The South Boston Piers/Fort Point Channel Transit Alternatives Study will provide important new service in the project study area, if implemented. The Proposed Action will not affect MBTA plans adversely because of intensive coordination and joint planning efforts which have been ongoing for many years.

Major real estate projects planned in downtown Boston, including the new Boston Garden multi-use complex, the new Aquarium in Charlestown, and new developments of the Boston Harbor waterfront areas, will be under construction at the same time and in close proximity to portions of the Artery/Tunnel Project. The North Point development project is also being planned by others in Cambridge along the Charles River. The Proposed Action will not adversely affect plans by others as a result of the continuing consultation process with the Cities of Boston and Cambridge and abutters to devise compatible design and construction plans.

The overall, long-term effects of the Artery/Tunnel Project together with these other projects are positive since they will improve environmental quality and support the continuing cultural and economic development of the region. In addition, the potential for important adverse impacts on the natural environment is expected to be minimal due to the extensive mitigation measures planned. In conclusion, the incremental impacts of the Artery/Tunnel Project and other projects are not expected to adversely affect current conditions in the affected environment.

The Artery/Tunnel Project will have an overall impact which is generally positive because the considerable transportation, economic, energy conservation, urban design parkland expansion and other benefits substantially outweigh the adverse impacts such, as the unavoidable filling of wetlands.

18.4 RESOLUTION OF ISSUES RAISED BY AGENCIES

Both the Army Corps of Engineers and the Environmental Protection Agency raised the issue of the combined effects of the Artery/Tunnel Project and other projects. The above discussion responds to this issue.

Chapter 19 – Short-Term Uses of the Environment and Long-Term Productivity

Chapter 19

SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

This chapter discusses in general terms the relationship of local short-term impacts and use of resources and long-term productivity with the Proposed Action.

19.1 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The transportation improvements included in the Artery/Tunnel Project have been identified, based on State and local comprehensive planning, as needed elements to meet current and future traffic and transit requirements within the context of present and future land use development. Therefore, the short-term use of resources required to implement the project is consistent with the maintenance and enhancement of the long-term productivity of the Boston metropolitan area and other areas of the Commonwealth.

The total construction period for the entire Artery/Tunnel Project will be approximately 9 years, although specific elements of the project will be completed in shorter time periods (see Chapter 20). Construction of the project has been planned to minimize impacts on the environment by maintaining traffic operations on the existing elevated Central Artery while the new depressed facility is being constructed, and by maintaining six lanes of capacity on the Surface Artery and Atlantic Avenue during construction of the project. Temporary construction haul roads under the Central Artery and in South and East Boston will reduce the effects of construction activity on local traffic flow. Traffic detour management will provide for uninterrupted traffic flow during construction.

Existing public parking spaces under the Central Artery, which will be displaced due to project construction, will be replaced at new sites. Potential neighborhood impacts, such as increased use of local streets by construction vehicles, will be controlled by contract specifications including, for example, requiring construction vehicles to use project haul roads and other designated haul routes. The use of barges to transport excavated materials to marine disposal sites will reduce or eliminate construction truck traffic that would otherwise occur in some neighborhoods.

Noise and vibration effects of the construction activities, particularly near sensitive receptors along the alignment, will be reduced by requiring that construction activities occur predominately during normal daytime working hours, by the use of temporary noise barriers, by requiring that construction equipment meet local and Federal noise regulations, through the use of low-impact construction methods, and by imposing limits on the times when the noisiest activities (such as pile driving and jackhammering) can be conducted in noise-sensitive areas.

Air quality effects during construction, caused by detouring of traffic and by the construction activities, will be minimized by the sensitive scheduling of the construction activities, by imposing maintenance programs for construction vehicles, by specifying detour routes that avoid or minimize traffic delays, and by modifying existing traffic controls and street geometries. These modifications could include changes to traffic signal timings and/or installing temporary signals, removing on-street parking in certain areas, remarking curbing and pavements, and installing jersey barriers. These measures will be specified in detail based on consultation with local agencies during completion of the final project design. Tarpaulins or other suitable covers will be required on trucks hauling excavated materials to control dust; other measures such as wetting of exposed earth and use of dust control agents will be incorporated into construction specifications. The City of Boston and State air quality requirements will be followed.

Siltation of Upper Fort Point Channel, the Charles River, and Boston Harbor during dredging operations will result in increased turbidity, although the impact is expected to be minor and may be controlled by use of silt curtains. The impacts of underwater blasting of rock near the edge of the Boston Marine Industrial Park (Subaru Terminal) area on marine life and on vibration levels will be controlled by using small charges, predrilling of charge holes, and other specialized blasting techniques.

Groundwater levels will be monitored and corrective measures will be taken as necessary during the construction period to minimize the potential effects of the project on the water table. The potential displacement of rodents into buildings in the vicinity of the project alignment will be controlled by a comprehensive and aggressively enforced rodent control program.

In the long term, the Proposed Action will result in substantial improvements to transportation services and potential increases in development opportunities for the Boston area. These transportation benefits include substantial savings in travel time and energy consumption by the motoring public. The Proposed Action also will improve the movement of people and goods to Logan Airport, resulting in economic benefits to the region. Airport activity, including number of passengers, changes in airline operations, and facilities development, is not expected to be affected by the project, since airport operations are more responsive to regional and national economic forces. In addition, the Proposed Action will improve access to maritime operations and commerce in the designated port areas of the Boston Inner Harbor during and after construction. The deep water port functions west of the Third Harbor Tunnel will not be affected by the profile of the tunnel.

The Proposed Action will reduce traffic levels on local streets in the North End, Chinatown, and South Boston, thereby improving the quality of life in these neighborhoods. In South Boston the project, and particularly the Bypass Road, will remove truck traffic (some carrying hazardous cargo) from local residential streets.

Improvements in air quality and decreases in noise levels in the project area will occur through implementation of the Proposed Action, due to improvements in traffic flow, placement of large volumes of traffic in tunnels, and removal of the existing Central Artery viaduct.

Removal of the existing Central Artery viaduct will also improve aesthetic conditions in downtown Boston. Its removal will allow visible and/or physical reconnection of the downtown and adjacent neighborhoods currently severed by the elevated roadway structure, and will allow possible development on approximately 27 acres of land above and adjacent to the depressed Central Artery (see Joint Development Appendix). In addition, alignment changes since the FEIS/R will create new parcels adjacent to the project right-of-way. The Proposed Action will result in increased tax revenues and employment or recreational opportunities in the area, depending upon the nature of development ultimately selected for these newly created parcels.

Removal of the Central Artery viaduct in downtown Boston will result in an urban context more compatible with adjacent historic structures and districts, and will strengthen the aesthetic aspects of historic districts.

Short-term use of parkland in the Area North of Causeway Street will be offset by major long-term parkland improvements and expansions as mitigation measures along the Lower Charles River.

In addition, the East Boston Memorial Stadium Park at Logan Airport will be enlarged and enhanced as a result of the Proposed Action. This will be made possible by relocating the airport access road to the northeast side of the park, away from the neighborhood. Landscaping improvements will be provided at the park as well.

The short-term use of Spectacle Island in Boston Harbor as a confined marine disposal site for construction materials will have substantial long-term benefits to the region. The disposal of dredged and excavated material on the island will stabilize and cap this former uncontrolled landfill. As part of the landfill closure process, appropriate measures will be taken to control and treat any existing leachate emanating from the landfill. The island will be made usable for future development, including recreation as a component of the Boston Harbor Islands State Park, or perhaps for other uses by other public agencies. Improved upland diversity and quality will improve habitat for birds and other wildlife associated with aquatic ecosystems.

In summary, the Proposed Action will include measures to mitigate potential adverse impacts. With these commitments, the short-term construction period impacts will be minimized while enhancing the long-term productivity of the environment.

The cumulative impacts of the Proposed Action outlined in Chapter 18 are considered beneficial to the regional environment and far outweigh the short-term local adverse impacts.

19.2 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

There were no issues raised by public agencies.

Chapter 20 – Summary of Construction Activity

Chapter 20

SUMMARY OF CONSTRUCTION ACTIVITY

This chapter presents a summary of how the Artery/Tunnel Project will be built, an assessment of its temporary effects during the construction period, and the mitigation program for which planning is already underway and which will continue into final design and construction. It concludes with a summary of several issues raised by public agencies and responses to these issues.

A more detailed treatment of construction staging and sequencing, and the means of meeting a number of commitments which were made in the FEIS/R to minimize disruptive influences of construction, including the Replacement Parking Program, Maintenance of Traffic Plan, and Mitigation Program, are contained in appendices to this document.

20.1 PROPOSED CONSTRUCTION PLAN

The Proposed Action involves construction of newly built and reconfigured mainline urban highway, much of it in tunnels, through and adjacent to central Boston's business districts, residential and waterfront areas, Harbor and other waterways, and regional airport, fundamentally altering and expanding the heart of the metropolitan highway system.

Building a multilane road through a densely developed part of Boston will be a challenging task. The Proposed Action is being planned, designed, scheduled, and organized to meet this challenge with minimal disruption. For example, much of the new road is to be placed along the same right-of-way as an existing highway and surface street system, which will be kept in full operation throughout construction. Surface traffic in the Central Area will be maintained by phasing construction activities so that a minimum of three lanes of northbound and southbound capacity between High and North Streets and two lanes of northbound and southbound capacity between North Street and North Washington Street are available throughout the construction period. Some of this capacity will be obtained by the elimination of parking along the Surface Artery, Atlantic Avenue, and Purchase Street, and by street crossings and detour routes described in the Maintenance of Traffic Appendix.

However, some interference with the environment, nearby facilities, and established patterns of activity is inevitable. These adverse effects are temporary, and their severity will depend to a great extent on the type of construction employed, how it is carried out, and what controls are exercised.

A mitigation program is being developed relying on experience with local projects, which have been constructed successfully under similar conditions [such as the Southeast Expressway reconstruction by the Department and the Southwest Corridor transit/railroad project by the Massachusetts Bay Transportation Authority (MBTA)], and knowledge gained from large urban transportation projects in other cities. The components of this program and other measures will be developed further, modified, and refined as the project is implemented, in response to public agency and local community review, final design refinements, and more detailed understanding of the temporary effects of construction as they will occur and evolve.

20.1.1 Construction Activities

Roughly half of the project will be constructed within the existing Central Artery right-of-way, and half on a new right-of-way through developed industrial and undeveloped areas of South Boston and Logan Airport. Almost 40 percent of the project will be underground in tunnels, open cuts, or depressed boat sections, with the remainder involving at-grade roadways, viaducts, and bridges (see Figure 20.1).

Immersed tube tunnel sections will be used to cross Fort Point Channel and the Boston Inner Harbor. Cut-and-cover tunnels will occur throughout the Central Artery portion of the project adjacent to the North End and downtown Boston, as well as for sections of roadway in the I-93/I-90 Interchange, South Boston, and Logan Airport. Transition sections from tunnel to grade and surface roadway will be built throughout the project, with the most extensive such segment being the South Boston Bypass Road. Elevated roadways (both viaducts and bridges) will be the predominant type of construction in the Area North of Causeway Street, including a bridge over the Charles River, the I-93/I-90 and Massachusetts Avenue Interchange Area, and the Logan Airport access and egress roads. The types of construction, methods, equipment, special measures, and materials which will be used in these areas are summarized below.

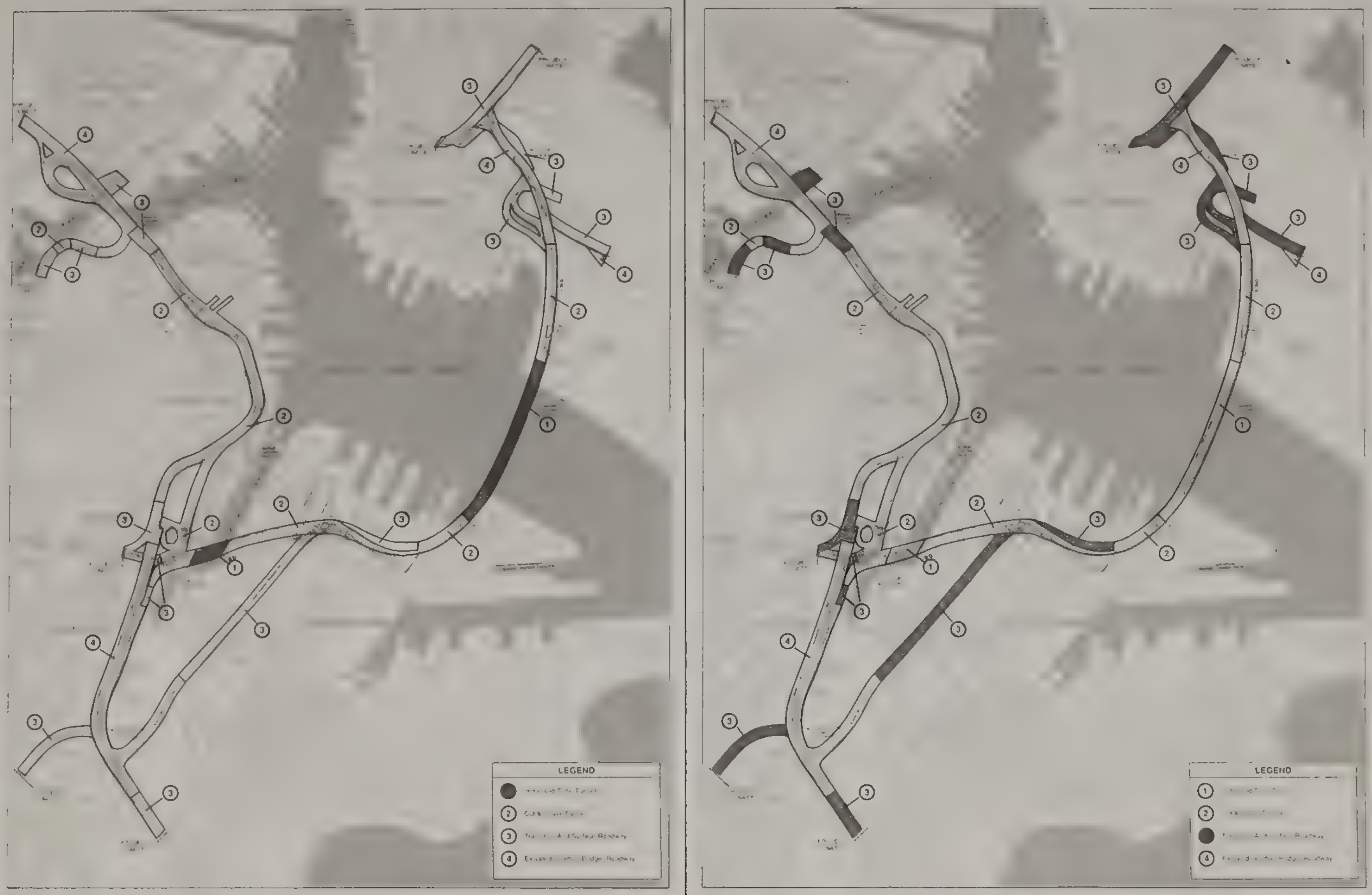
20.1.1(a) Cut-And-Cover

This method of construction generally involves installing roughly parallel support walls, removing the soil material between them, building the tunnel structure in place, covering it with fill, and restoring the surface. The area between the support walls may be temporarily covered, or decked over to maintain surface activities, while construction continues below.

The specific application of this method in the Central Artery area will involve, in addition to the routine steps outlined above: supporting the existing elevated roadway structure and other existing structures in the area; excavating for and constructing the rectangular-shaped box containing the new roadway; backfilling and reconstructing surface streets; and demolishing the existing structure (see Figure 20.2).

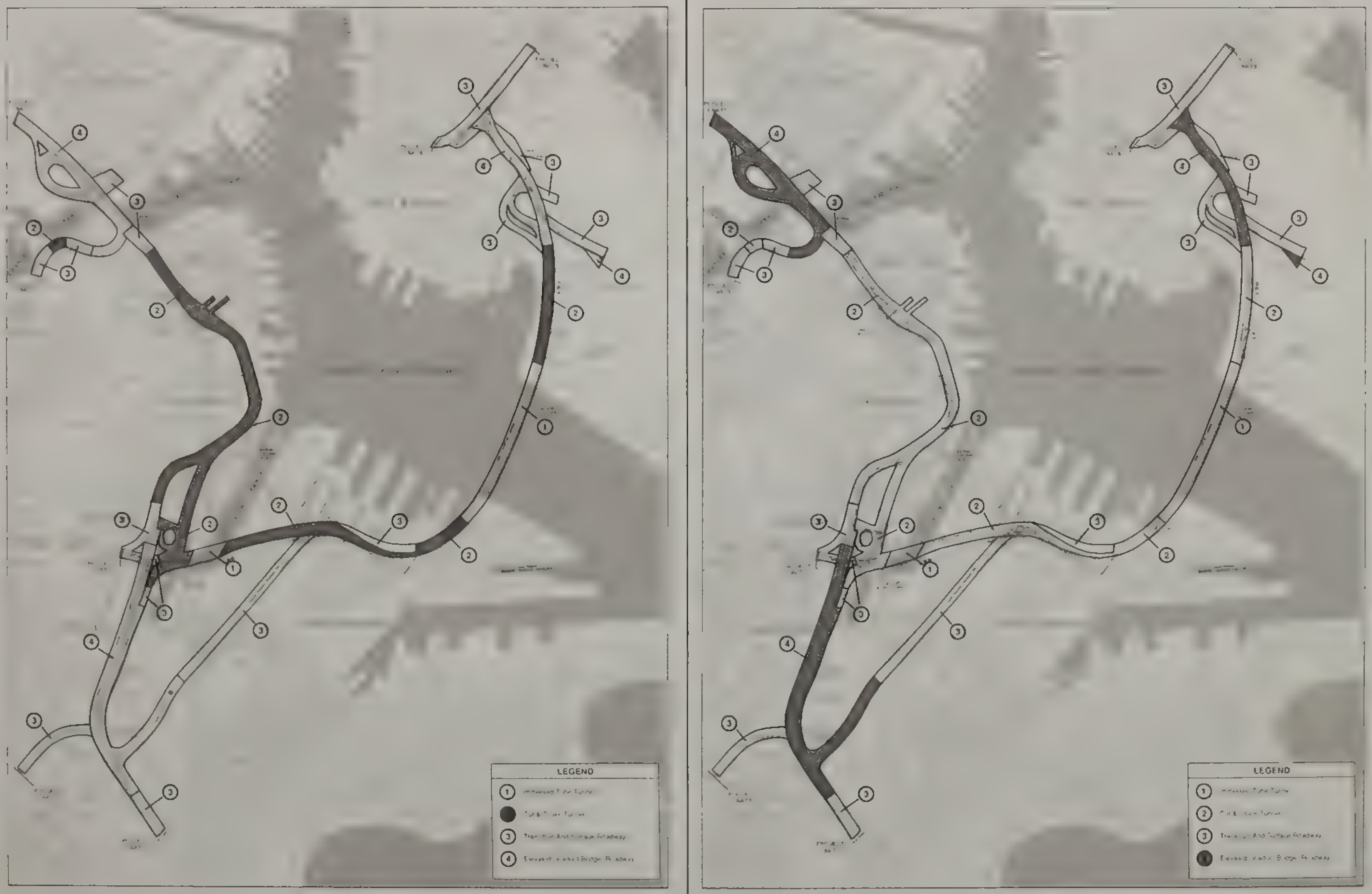
Below-grade construction will be conducted beneath decked surface streets during an extended period, and will typically require widths from 80 to 250 feet and depths of up to 95 feet. Most of the surface area below the Central Artery will be decked following initial utility relocations and slurry wall installations. Excavation and tunnel construction activity will take place primarily beneath this deck in order to maintain surface street traffic. However, construction materials will be delivered from the surface, which will affect street traffic to some extent. During demolition of the existing elevated structure and street restoration, work will primarily be on the surface.

Various methods will be used to support or underpin adjacent structures and railroad tracks throughout the project, utilizing walls, piles, piers, and drilled caissons as necessary. The construction of support walls and excavation will employ earth moving equipment, loading directly into trucks, and low headroom equipment for work under the existing elevated Artery structure. Cranes will be used to remove material from below the decking with clamshell


LEGEND
Immersed Tube Tunnel
Cut & Cover Tunnel
Transition And Surface Roadway
Elevated Viaduct Bridge Roadway

Immersed Tube Tunnel

Transition and Surface Roadway

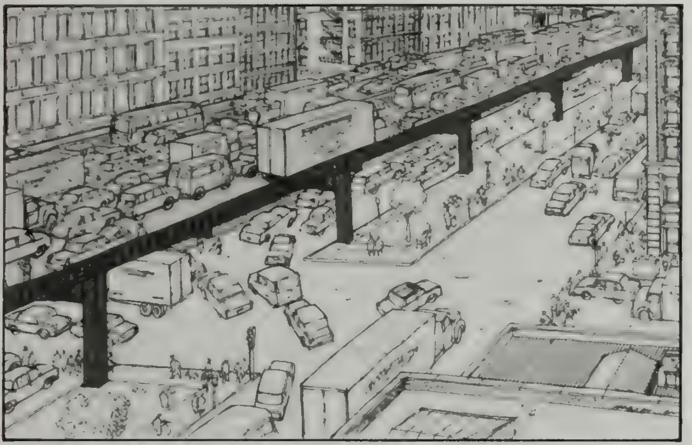

LEGEND
Immersed Tube Tunnel
Cut & Cover Tunnel
Transition And Surface Roadway
Elevated Viaduct Bridge Roadway

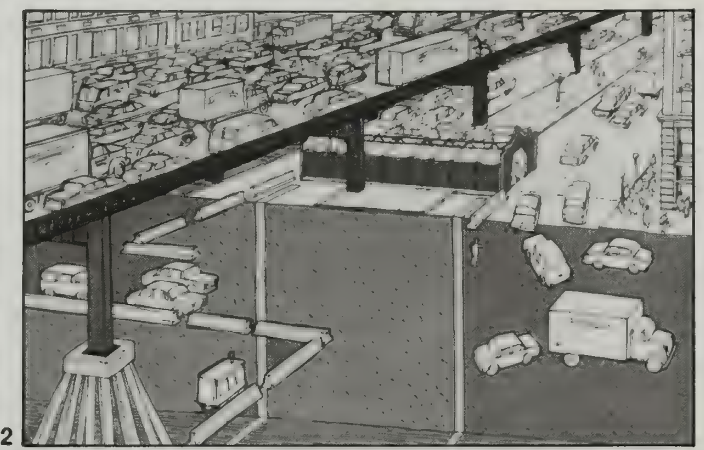
Cut & Cover Tunnel

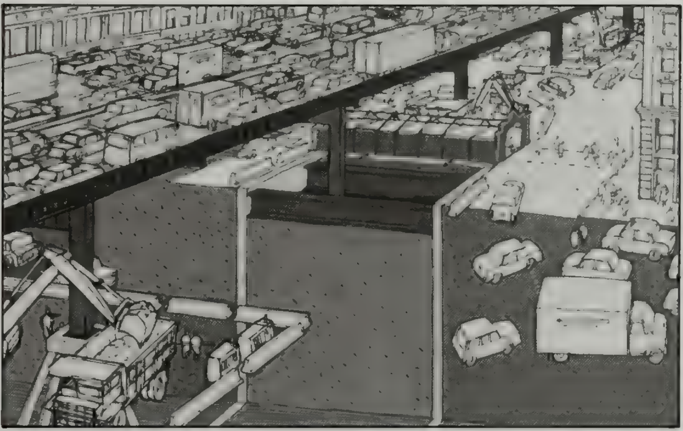
Elevated (Viaduct Bridge) Roadway

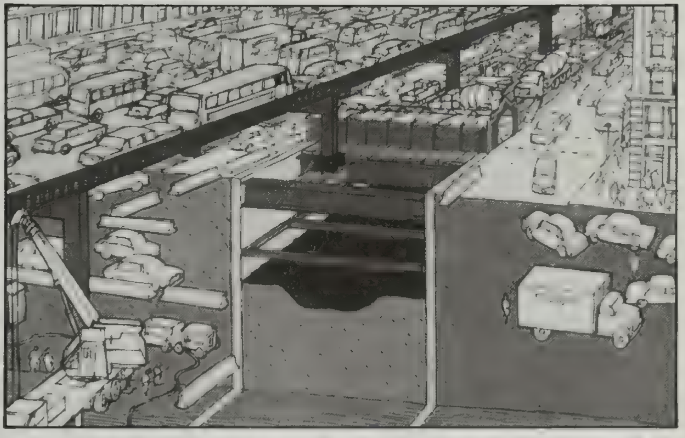
FIGURE
20.1 Project Structures

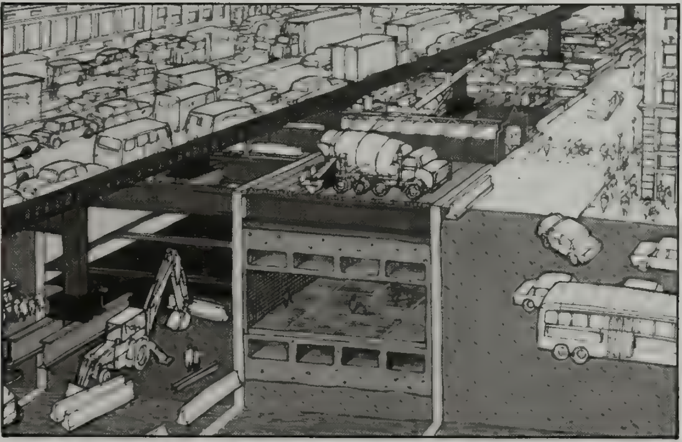
THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

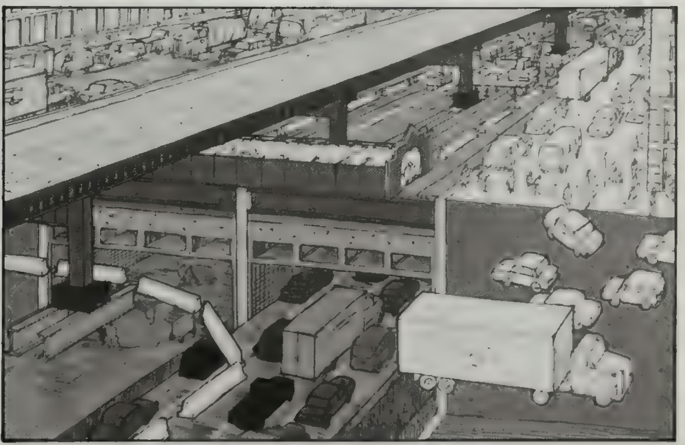

1

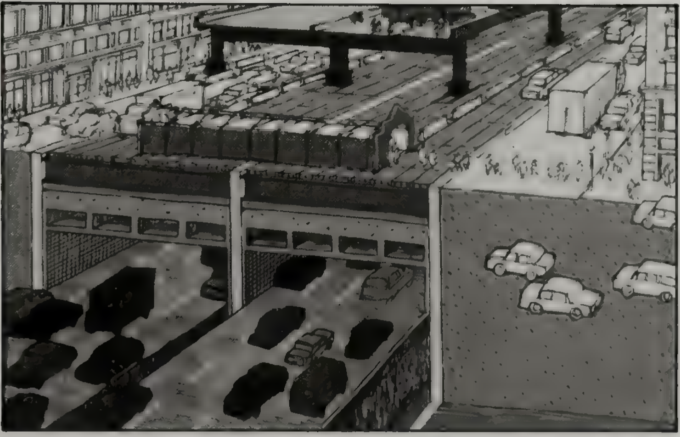

2


3


4


5


6


7

Depressing An Artery, Step by Step

These drawings, by noted illustrator David Macaulay, show how the new underground highway will be built while keeping the existing elevated Central Artery **(1)** and surface city streets open. First, two 4-foot-wide "slurry walls" will be made by pouring concrete as deep as 80 feet into the ground **(2)** on either side of the highway section to be constructed. Beams between the walls **(3)** will support the elevated highway. The highway section is then covered with decks to allow car and pedestrian traffic while construction proceeds, and workers excavate the dirt from under the deck and between the walls **(4)** to build the new underground highway **(5)**. The northbound lanes of the new underground Central Artery **(6)** are scheduled to open first, then the southbound lanes, after which workers will begin dismantling the existing elevated highway **(7)**.

FIGURE
20.2

Depressed Central Artery Construction Sequence

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Our thanks to David Macaulay
for his participation in this project.

buckets, loading directly into trucks. Conveyor systems may also be used to remove excavated material where feasible.

20.1.1(b) Steel Shell Immersed Tube

This construction method involves building tunnel sections on land in the form of steel vessels, towing them to Boston Harbor, and lowering them into a trench excavated into the Harbor bottom (see Figure 20.3). Dredging and tunnel immersion activities will be conducted from barges temporarily anchored in the Harbor. Where rock is encountered, explosives will be used. No bored or mined tunnels are contemplated.

The 12 binocular steel shell tube tunnel sections required for crossing Boston Harbor can be constructed in dry docks or on shipways (land-based facility) and can be side-launched, end-launched, or floated out (in the case of a dry dock) after fabrication. Since these tubes require only 6 to 9 feet of draft after launch (or after the dry dock is flooded), they can be towed great distances, if necessary. Accordingly, location of the tube fabrication yard will be the contractor's option and will take place at an established steel fabrication facility with water access.

After the tubes are fabricated and launched, they will be towed to an outfitting site where the interior concrete will be placed. Outfitting sites are usually, but not necessarily, located close to the tunnel alignment. Since a fully outfitted tube will draw approximately 40 feet of water, it is more difficult to tow them over long distances.

The tubes will be placed in a prepared trench excavated by a clamshell dredge and, where rock is present, by drilling and blasting from a specially equipped barge. Material will be removed for disposal by barges. Dredged material will be discharged into barges and transported to the disposal site. The tubes will be supported on a 2- to 3-foot-thick gravel foundation placed on the bottom of the dredged trench.

The tube section will be towed to the site and positioned at the placing barges, which straddle the floating tube and are joined by box girders equipped with lowering blocks, deck hoists, and cables. As placing starts, the tube will be weighted (with water or heavy stone or concrete blocks) to provide the ballast necessary to hold the tubes down safely during and after the joining operation.

Each tube will be aligned, surveyed, and joined with rubber gaskets. Assuming tube laying begins near both South and East Boston, the closure joint will occur in general anchorage.

The tube will then receive final surveying, concrete ballasting, and placement of backfill to lock the tube in place laterally and protect it from Harbor activities and scour from Harbor currents. A 5-foot-thick protective rock cover will be placed over the entire structure. In the shipping channel and anchorage area, the profile has been set an additional 2 feet lower to allow for dredging maintenance.

20.1.1(c) Reinforced Concrete Immersed Tube

This construction method will be used to cross Fort Point Channel (see Figure 20.1). It involves building cast-in-place tunnel sections in a dry dock or a casting basin, flooding the basin, towing them to the final location, and lowering them into place. These sections have substantial water draft, which makes towing difficult. This type of fabrication is generally accomplished in close proximity to the final location.

The wide rectangular sections required for the I-90 extension through Fort Point Channel are wider than the narrow downstream bridge clearance widths, making remote tube fabrication impractical. These tunnel sections will be cast in a special basin constructed on the alignment adjacent to the Channel on its east bank and may use post-tensioned concrete. The sections will be joined and placed in a manner similar to that described for the steel shell immersed tubes. One major difference is that the tunnel sections will rest on piers to span the MBTA Red Line tunnel, which runs below Fort Point Channel longitudinally.

20.1.1(d) At-Grade Construction

This method uses standard techniques and equipment for subbase preparation and paving. It includes construction of transition roadway segments from below grade to surface, and will occur at numerous locations throughout the project area (see Figure 20.1, locations numbered 3). In addition to the mainline highway, at-grade construction will involve temporary and permanent relocation of local streets and service roads, and restoration of streets following completion of mainline construction. Construction in the Central Area will be at grade along Atlantic Avenue, Purchase Street, and the Surface Artery. Surface construction will affect numerous small areas throughout the corridor where work will be conducted for relatively short periods.

20.1.1(e) Above-Grade Construction

This method generally requires erection of structures and foundations on steel or concrete piles utilizing cranes and pile driving and/or auguring equipment. This type of construction will occur primarily at interchanges where elevated connections to existing highways and bridges are required, and will be used for the bridges over the Charles River (see Figure 20.1, locations numbered 4).

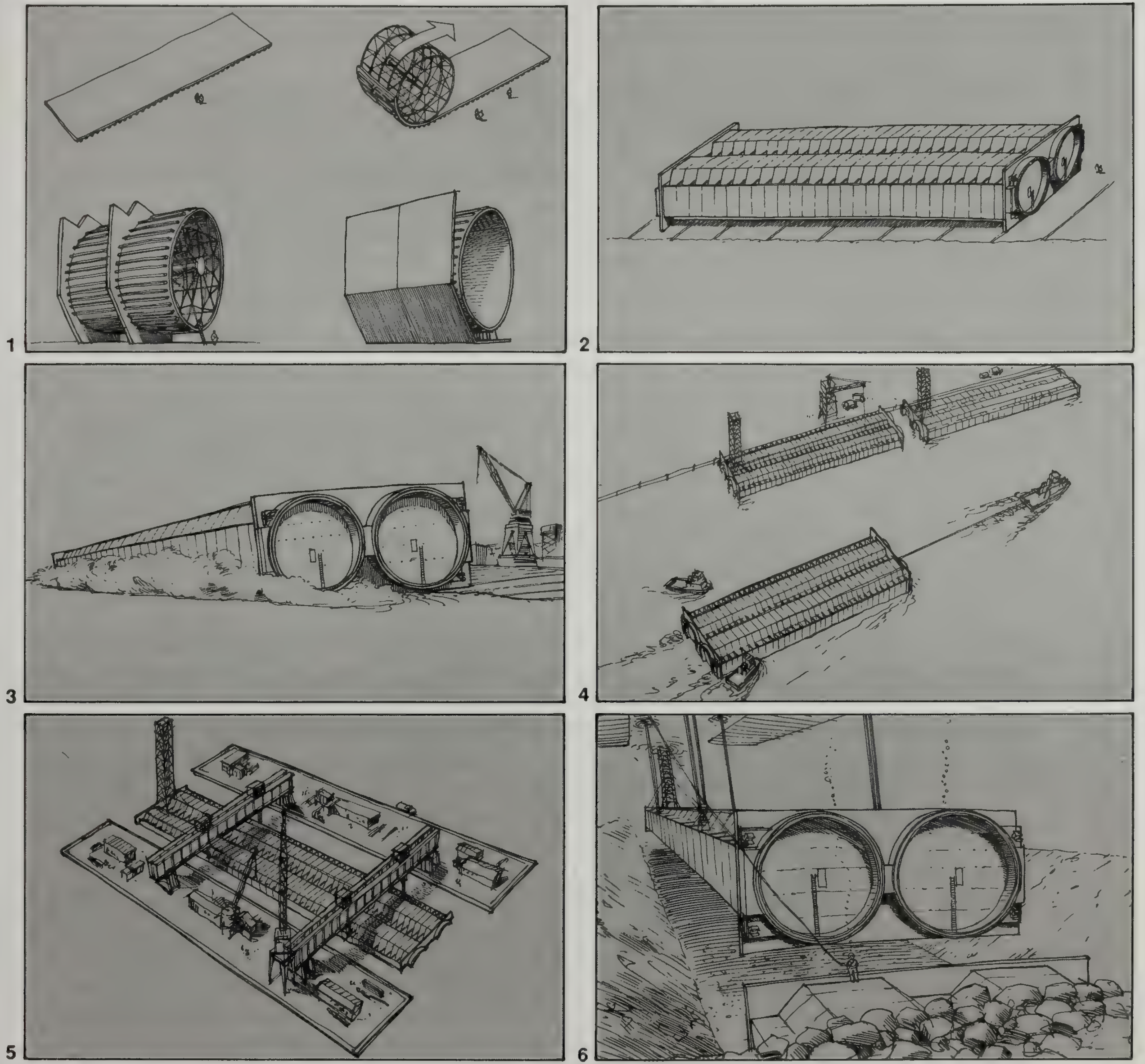
For example, construction of the new two-tier Charles River bridge will involve a complex sequence of steps designed to facilitate connections to the new Central Artery North Area Project (CANA) loop ramps, and ramps to the North Station area and Leverett Circle/Storrow Drive, while maintaining traffic on the existing bridge and pedestrian circulation through the area and along the riverbanks.

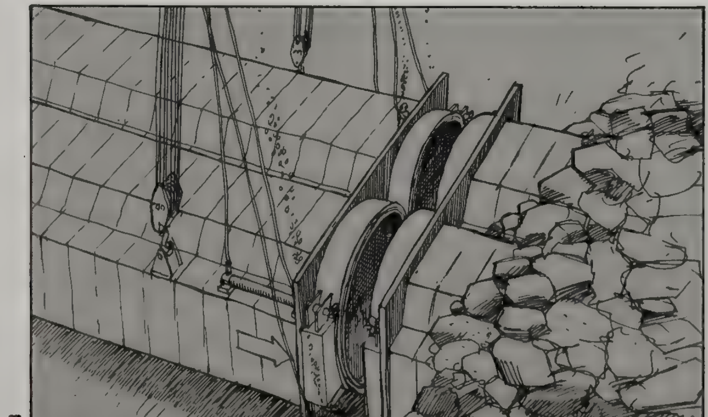
Final selection of the main span bridge type (concrete segmental or cable-stayed) will determine the erection procedure. Other bridge types under study include precast concrete girders, steel stringers, steel box beams, and steel trusses. These bridges can be erected from barges or from land.

20.1.1(f) Logistics

The overall project, and each subarea, will involve a complex logistical support system for the provision and delivery of construction materials, removal and disposal of excavated, dredged and demolished materials, and space to accommodate the needs of contractors and construction workers, including temporary storage and parking. These topics are summarized here and discussed in greater detail in the Section 20.2.1(b), Local Area Effects on Traffic.

Construction Materials. The Proposed Action will require large amounts of construction materials, primarily concrete and steel. An estimated 3.8 million cubic yards of concrete and 200,000 tons of steel must be delivered to the site in the most efficient and timely, and least disruptive, manner. A temporary concrete batch plant in





Engineers will use the immersed tube method, illustrated by these drawings, to construct the Third Harbor Tunnel.

A trench will be excavated across the bottom of Boston Harbor. Twelve double-barreled tubes, each approximately 330 feet long, 80 feet wide, and 40 feet high, will be fabricated by rolling flat steel plates around circular steel frames **(1)**. These tubes **(2)**, which are sealed at both ends, will be launched **(3)** and then towed to a staging area **(4)** in Boston Harbor. A large catamaran-type barge **(5)** will be used to lower each tube section into the prepared trench **(6)**. As each tube is placed, divers will join them with mechanical couplers similar to those used for connecting railroad cars **(7)**. When interior work and ventilation facilities are complete, the tunnel will be opened to traffic.

FIGURE

20.3 **Third Harbor Tunnel Construction Sequence**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Our thanks to David Macaulay
for his participation in this project.

East Boston will supplement existing concrete supply in the area, and serve to reduce concrete truck traffic throughout the area of the project (see Figure 20.4).

The batch plant will probably be an open-air operation with 35-foot-high stockpiles, a conveyor, a cement silo approximately 40 feet high and 12 feet in diameter, a mixer, a 30,000-gallon boiler for producing warm water for concrete in winter, a dispatch office, a laboratory, a mechanic's shop, and overnight parking for about 25 trucks. The site area will be approximately 4 acres.

Excavated Material. An estimated 13.5 million cubic yards of excavated material will be removed and disposed off-site in order for construction of the project to proceed. The logistics for accomplishing this excavation include four strategically located barge loading facilities: on the Charles River near North Station; Fort Point Channel/Boston Edison site; the Boston Marine Industrial Park (BMIP) site in South Boston; and the Massport Bird Island Flats adjacent to Logan Airport. The facilities will each have approximately 250 linear feet of docking space, a 25-foot-high (or higher) movable crane, and a dump trough or surge area approximately 22 feet wide by 200 feet long (see Figure 20.5). Excavated materials will be dumped into the trough or storage area by dump trucks and moved from trough to barge by the portal crane. Each site area will be approximately 1 to 1.5 acres.

Landside movement of excavated materials -- to and from the barge loading areas, and to the extent possible, construction materials delivered to the project -- will occur largely within the project right-of-way or on specially designated haul roads to keep construction vehicles off local streets. Ten-wheel dump trucks will move material on a three shift per day basis in the Central Artery and I-93/I-90 Interchange areas during peak construction periods. In South and East Boston contractors will haul excavated material on a two shift per day basis. Eighteen-wheel dump trucks, which have about one-third greater capacity, will be used at locations where sufficient maneuvering space is available. The peak movement of construction vehicles is expected to occur in 1994, when a maximum of 1,300 truckloads per day will move throughout the project area [see Section 20.2.4(b) for details on truck traffic].

Waterside movement of excavated material from the four barge loading facilities and from waterborne dredging equipment involved in construction of the Third Harbor Tunnel and Fort Point Channel crossing will be by deck or hopper barges, and dump scows respectively. Barge traffic in Boston Harbor will peak in 1994, when a maximum average of 15 barge loads of material per day will be removed [see Section 20.2.1(e) for a discussion of barge traffic].

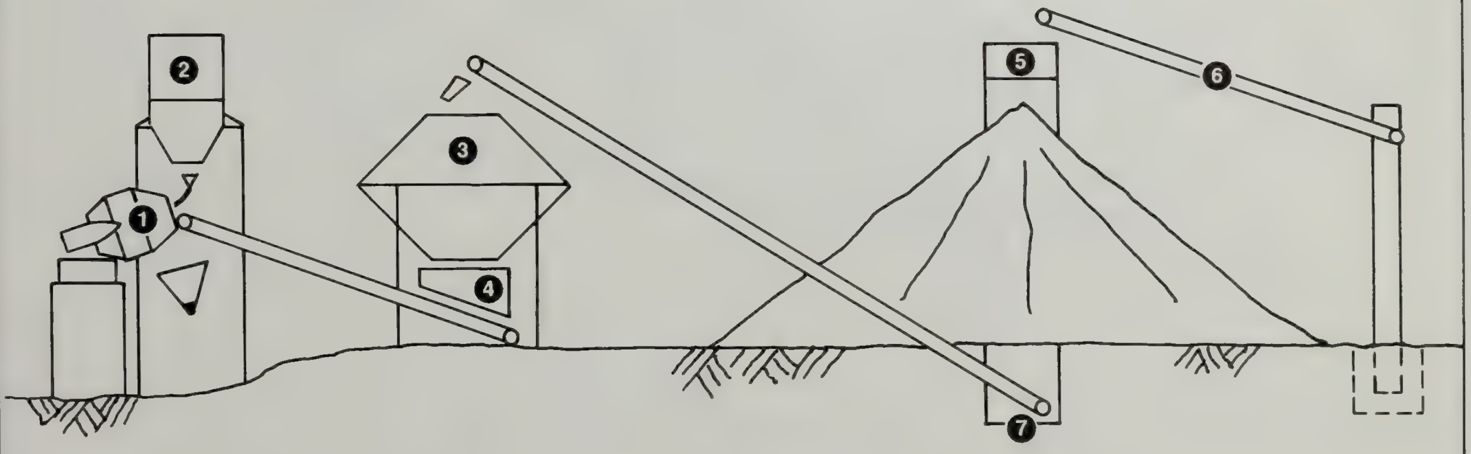
The physical and chemical characteristics of this excavated material are the subject of several completed studies and ongoing Department programs. Because their characteristics are important elements in determining the alternatives acceptable for disposal of these excavated materials, the detailed physical and chemical description of the excavated materials, and of these studies and ongoing programs, is presented in conjunction with the evaluation of materials disposal presented in Chapter 4 of Part II of this SEIS/R.

Reuse Of Excavated Fill As Backfill. Once the underground portions of the project are constructed, over 4 million cubic yards of backfill material will be needed to cover the underground roadway sections. The barge loading facilities used to transport excavated material to off-site disposal locations may also be used for delivery of a portion of this backfill. Because reuse of excavated material as backfill could reduce the amount of excavated material to be disposed off-site, the Department is committed to and will continue to evaluate reuse of these materials on-site. However, the ability of a material to serve as backfill is limited by the use of the site it must ultimately support. For example, backfill in proximity to roads, utilities, and structural foundations must possess adequate strength characteristics and be relatively incompressible so that settlement or movement of the soil is minimized. In these instances, the backfill must meet strict limitations on grain size distribution and compaction. The fill material excavated from the project would not conform to these requirements because of its organic content and plastic clay. In certain areas remote from planned or future structural developments (for instance, within interchanges or planned open spaces), the fill material may be used but would require drying and storage in the interim. Bird Island Flats may prove to be one such area. Reuse of excavated material in these areas will continue to be evaluated by the Department. However, it is estimated that less than 100,000 cy of the material excavated could be reused. For a more extensive study of this subject, please see "Soil Removal, Disposal, and Backfill," Bechtel/Parsons Brinckerhoff, March 1988.

In addition, the Department is evaluating the benefits for on-site use of a mobile asphaltic cold mix process to crush and recycle excavated material with asphalt emulsion. The range of potential uses for this product vary depending on the composition and ultimate use of the product on-site. One potential use which has been identified is in paving support areas such as construction staging areas.

Other Debris. The construction contractors will remove approximately 400,000 cubic yards of broken concrete and asphalt rubble and about 100,000 tons of metal. During the removal process these materials will be divided into the following categories:

Category	Description	Approximate Quantity
1	Broken asphalt and concrete pavements plus underlying base course and cobbles	340,000 cubic yards
2	Broken brick and concrete from building demolition (free of wood and similar contaminants)	15,000 cubic yards
3	Broken brick and concrete from demolition (with wood and similar contaminants)	42,000 cubic yards
4	Salvageable metal (piling, rebar Dewey Square tunnel concrete-encased structural steel)	5,000 tons (piling) 3,000 tons (other)
5	Nonsalvageable metal (structural steel from elevated structures painted with lead based paint)	81,000 tons



❶ Mixer

❷ Cement Bin

❸ Aggregate Bin

❹ Aggregate Batcher

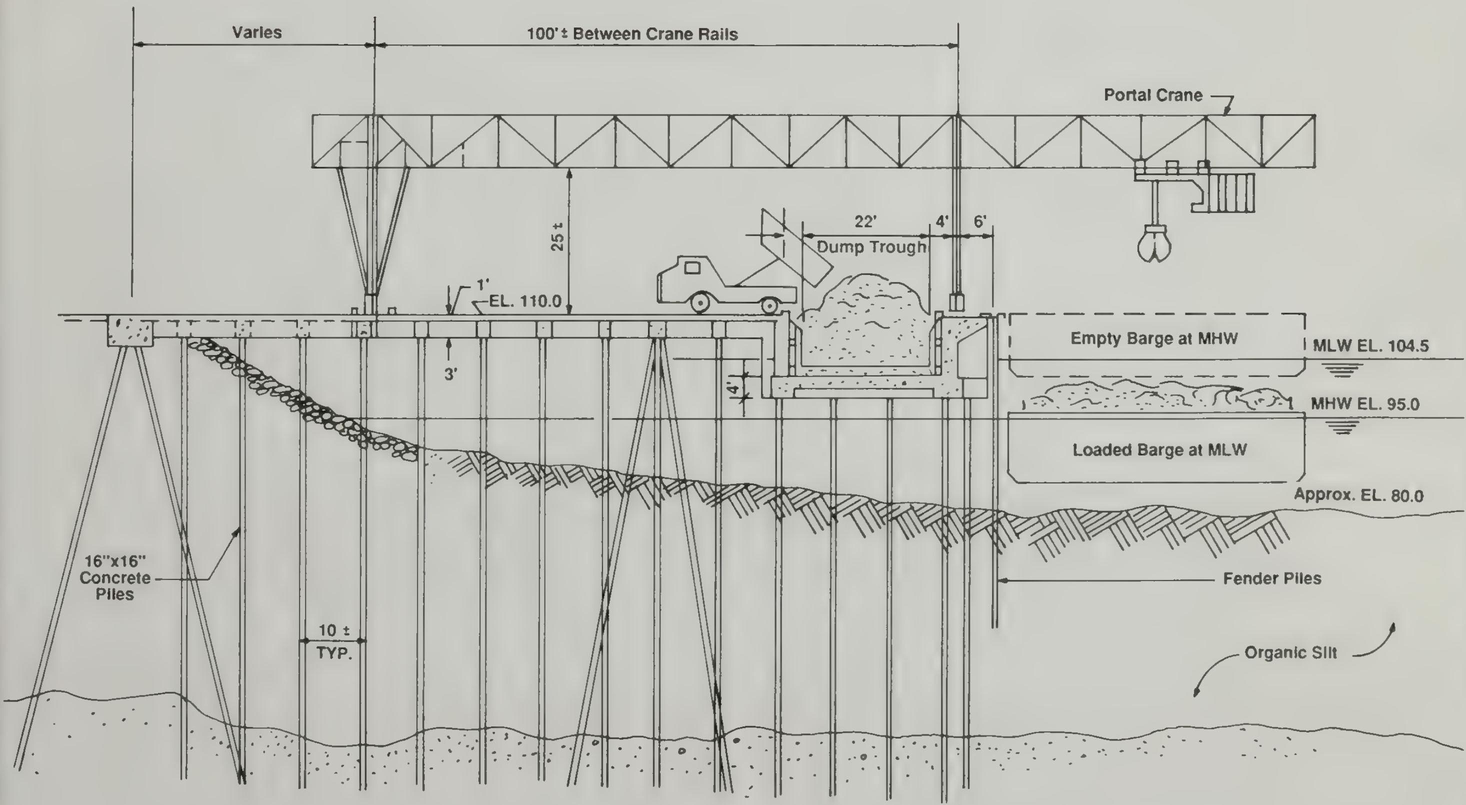
❺ Reversible Shuttle Conveyor

❻ Loading Conveyors

❼ Reclaim Tunnel

FIGURE 20.4 Concrete Batch Plant

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



FIGURE

20.5

Barge Loading Facility

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Category 1 and 2 material can be disposed by processing through a reclaiming plant that crushes and screens the debris to produce a subbase quality material for use in building roads, parking lots, and similar types of work. A reclaiming plant of this type is being constructed by the McCourt Company (January 1990) on their property in South Boston between C Street and the South Boston Bypass Road alignment, and may be available, along with other similar facilities, for use by the project.

Category 3 material usually is not considered acceptable for use in construction fills because it contains wood and other organic materials that will cause settlement with time. Consequently, this material is usually disposed in landfills (this was the case with the demolition material from the Travelers Insurance Building in Boston). However, Wheelabrator Eastern recently proposed to construct a recycling facility in Taunton, Massachusetts, that will be capable of recycling construction debris that contains wood. It may be possible to ship debris of this type to this facility via railroad or by truck.

Category 4 material will be salvaged and delivered to metal reclaiming plants. There is a plant of this type in Everett, Massachusetts, where most of Boston's salvageable metal is presently sent.

Category 5 material is not presently salvageable because of the lead based paint. One potential reuse would be the construction of reef-like structures for fish habitat. New disposal technologies and the possibility of recycling the material will be investigated.

Work Areas. Contractors will need both on- and off-site areas to store materials, maintain equipment, and conduct construction operations. Depending on the local area, temporary parking will be available for a small number of vehicles. Construction workers will be encouraged to travel to job sites on public transportation as employee parking will not generally be available.

20.1.1(g) Utilities

Over 5,000 separate underground utility elements have been identified within the project area, including communications, power, sewer, and water lines, and underground storage tanks. No major existing utilities will be affected by construction of the Third Harbor Tunnel. All other construction areas will involve various degrees of utility maintenance, and temporary or permanent relocation, with the greatest number of such occurrences found in the Central Area.

While continuous maintenance of service is a high-priority goal of this project, some short-term interruptions during tie-ins to new services, cable splicing, etc., are unavoidable. These planned activities will be kept to a minimum, coordinated with the affected utility agencies and users, and will be scheduled, programmed, and monitored as a part of the Construction Management Plan and Public Participation Program. [Major utilities affected by the alignment in each project area are shown in Appendix 1, Supportive Engineering Report (SER).]

20.1.1(h) Special Methods And Measures

As was discussed in the FEIS/R, special measures must be taken to ensure the integrity and operation of affected facilities and structures, and to provide for public safety. These measures include tunnel protection, underpinning overhead and adjacent structures, a movement and vibration monitoring program, and a casting basin (temporary dry dock). In addition, a conveyor system for the removal of excavated material is being studied for possible use as a mitigation measure in the Central Area and in East Boston.

Tunnel Protection. Special measures will be used for Orange Line tunnel protection and I-93 bridge erection in the Area North of Causeway Street. Special protection measures also are proposed for the Green and Orange Lines at Parcel 7, the Blue Line at State Street, the Red Line at South Station, and the Red Line under Dorchester Avenue. [These measures are described in section 20.2.1(d), Public Transportation.]

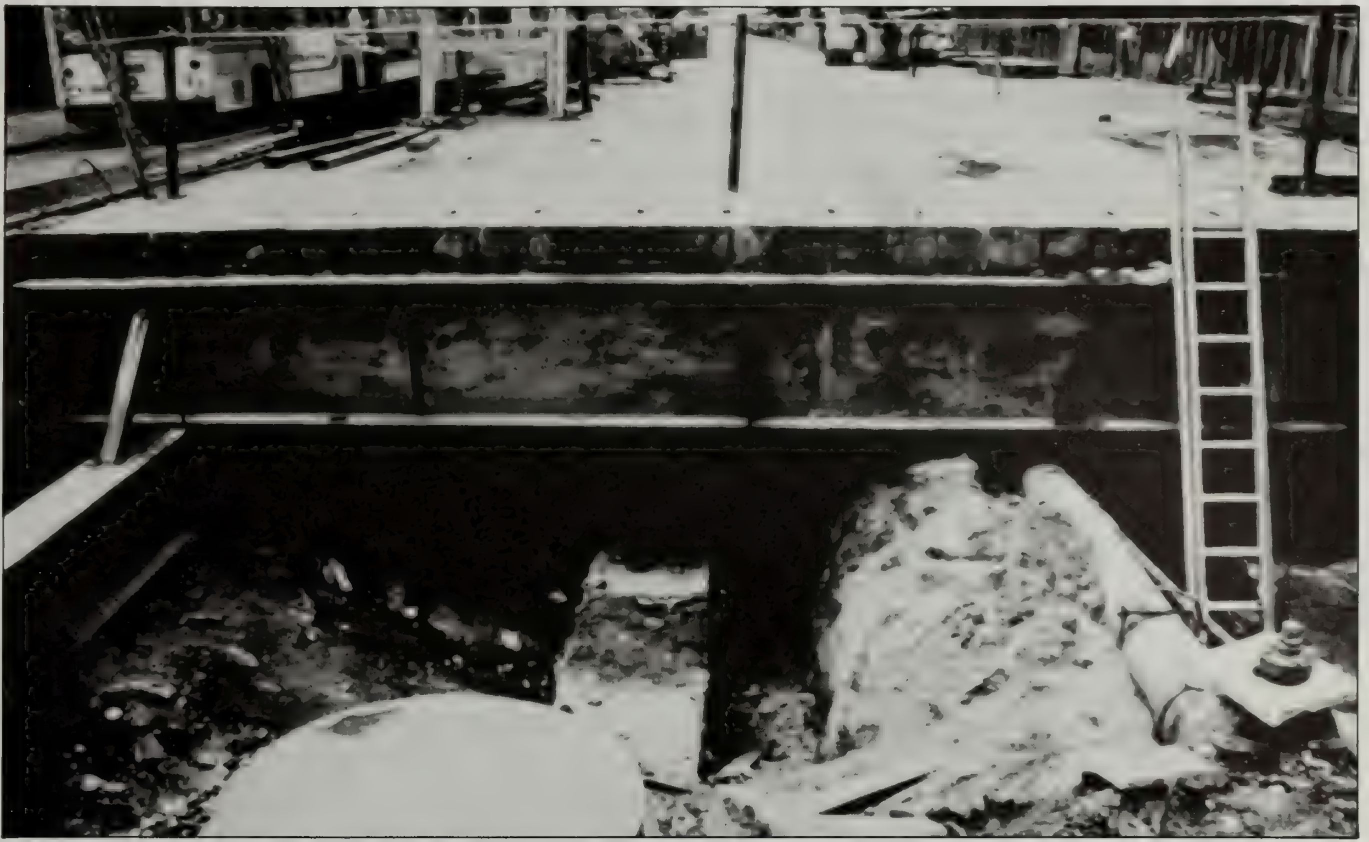
The crossing of Fort Point Channel is complicated by the presence of the MBTA Red Line twin-tube tunnel. The proposed tunnel must pass over the top of the MBTA structure with the top of the new tunnel protruding as little as possible above the existing Channel bottom. Therefore, tunnel sections will be founded on piers to bridge over the MBTA Red Line tunnels and avoid transmitting any load to the subway tunnels.

Underpinning And Bracing. Structures in or adjacent to construction activities in the Central Area which require special attention include the Federal Reserve Building, 211-213 Hanover Street, Harbor Towers garage, and Dock Square garage. Investigations will be conducted during final design to evaluate the need for underpinning and/or additional protective measures for buildings along the alignment.

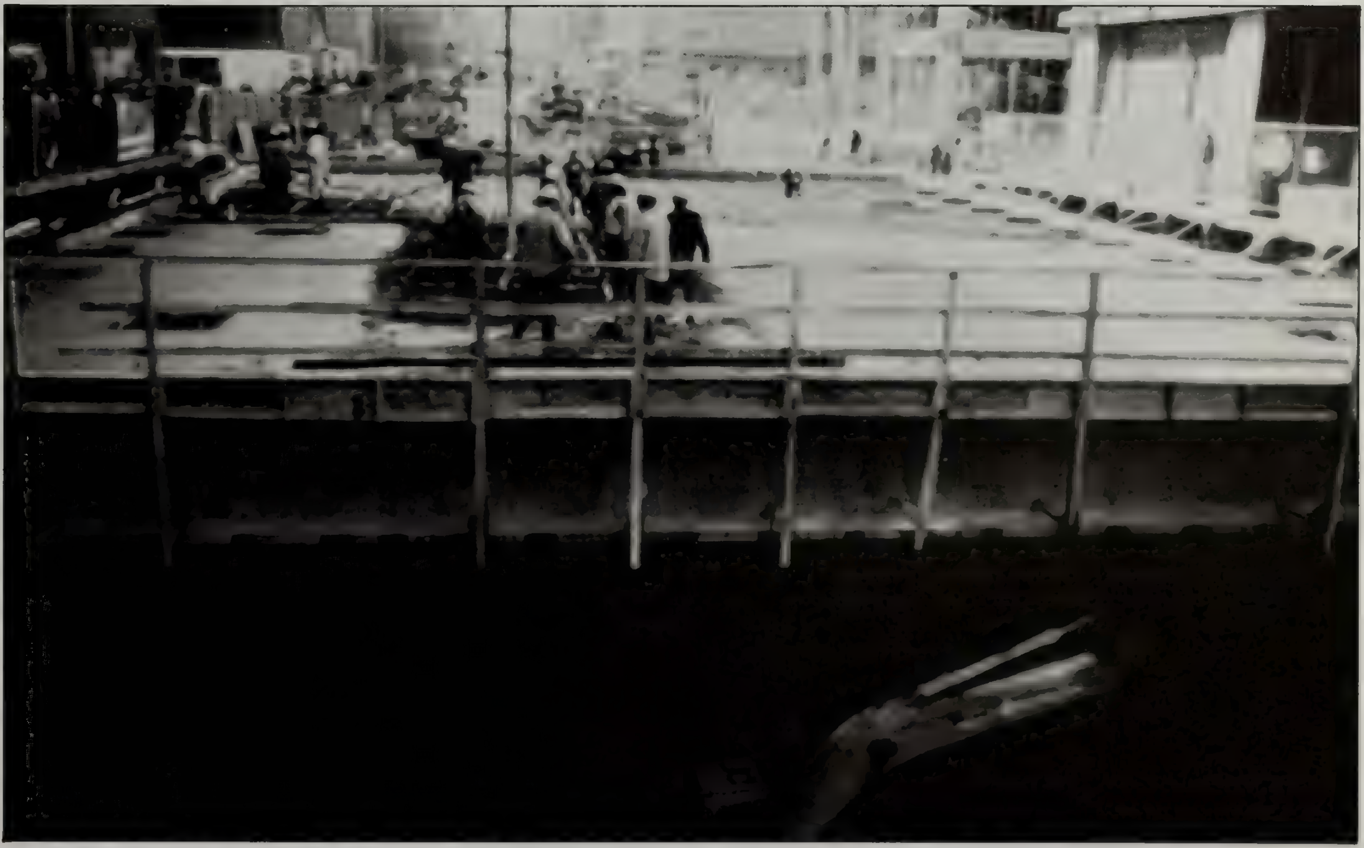
As tunnel excavation in the Central Area progresses downward, bracing and shoring members will be required to resist lateral pressures caused by soil loading and surcharge loads from adjacent structures. Because most of the excavation will be through clay and fill materials, and considering the proximity of adjacent building foundations, tiebacks will generally not be a viable option for providing lateral excavation support in the Central Artery area. A cross-lot bracing system will be required throughout most of the excavation (see Figure 20.6). Bracing installation will use techniques typically employed in cut-and-cover construction. Work will be carefully monitored for compliance with approved methods.

In South Boston, special measures will be taken to provide for the integrity of adjacent structures and the continued operation of affected businesses. Along A and B Streets and Northern Avenue, adjacent structures will be stabilized prior to tunnel excavation to minimize settlement. Investigations of other structures within the influence of project construction will be conducted during final design to evaluate the potential effects and the need for underpinning and/or additional protective measures. Also, access to Fishery Products, Nagle, Towle, and Stavis loading docks will be maintained by providing temporary decking as necessary. The Turner Fisheries loading dock will be provided with a permanent replacement dock. (For more details see the Supportive Engineering Report.)

Movement Monitoring. The excavation and bracing installation operations will include a program to monitor movements and deformations in the excavation support wall and adjacent structures. Movement detection instrumentation (including inclinometers, extensometers, and survey settlement markers) will be installed and read regularly. In addition, an extensive survey program will be employed to provide additional data on the performance of the excavation support and underpinning support systems used throughout the work. Unusual deformation patterns will be quickly adjusted with preplanned remedial measures.



View of temporary surface decking and grade beams. (Tunnel excavation will proceed below decking.)



Installation of grade beams and temporary surface decking (with construction activity below).

FIGURE

20.6

Cross-Lot Bracing Construction Example - Downtown Seattle Transit Project

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Excavations adjacent to existing structures in the I-93/I-90 Interchange area will require a detection-of-movement program to monitor and initiate prompt resolution of any vertical or horizontal movements. Dewatering requirements will be minimized by the use of cutoff walls with seepage removed from within the excavation, primarily using sumps. Piezometers (observation wells) will be installed to monitor any possible drawdown of the groundwater table. Replacing/recharging of water will be performed as necessary to avoid negative effects on adjacent foundations.

Casting Basin. The use of immersed tube construction was determined to be the most feasible method of construction for the crossing of Fort Point Channel. Building the crossing within cofferdams is not feasible due to poor soil conditions, potential instability of the MBTA Red Line tunnels if both the soil and water overburden are removed, and the inability to seal a cofferdam around the existing structures. The wide rectangular sections required for the six tunnel sections crossing the Channel and the restrictive bridge widths (Summer Street, Congress Street, and Northern Avenue) make remote fabrication impractical.

A casting basin (temporary dry dock) will be built on the east shore of the tunnel alignment between the shoreline and A Street (see Figure 20.7). The south side of the casting basin will be within the permanent project alignment. The north side will be approximately 100 feet north of the northern edge of the permanent alignment. Slurry walls with tiebacks will be used for three sides, with the west or Channel side constructed with cellular cofferdams. Total site area will be approximately 12 acres. The soil excavated from this casting basin area will be loaded directly onto barges in Fort Point Channel.

After the basin is excavated, four of the immersed tunnel sections will be fabricated of cast-in-place concrete. During this phase, several heavy construction vehicles carrying concrete, steel forms, and other materials will access the casting basin on a daily basis. Vehicles would enter the basin on a ramp located on the northern side of the casting basin and some could be stored there over night. A pumping system would probably be used to place concrete in the steel forms. It is possible that at some times construction could proceed with double or possibly triple shifts. However, activities affecting nearby residential areas would be limited to the daytime period.

The support piers (required to span over the MBTA Red Line) and the dredging will be done concurrently with the tunnel section fabrication and will be completed prior to breaching the cofferdam. The connecting tunnel section on the west shore at Dorchester Avenue will be completed to receive the immersed tube connection. The sections will be bulkheaded prior to flooding the casting basin. After the casting basin is filled with water, part of the cellular cofferdam will be removed and the sections will be floated into place. Once the tunnel sections are in place, ballast will be added and the sections lowered onto the piers. A similar procedure will be used for the remaining two sections in the western half of the basin.

Following the placing of the tunnel sections, the cofferdam will be reestablished and cast-in-place tunnel construction will proceed in the casting basin excavation itself. The basin will be at the same elevation as the Fort Point Channel tunnel sections, and as a result no additional excavation will be required within the basin. The cofferdam will be replaced with a permanent seawall, while the exterior slurry walls will be left in place. Following completion of the roadway tunnel, the casting basin excavation will be backfilled.

Permits required for construction of the casting basin will include Section 10 and 404 Permits from the Army Corps of Engineers, CZM Consistency Concurrence, Water Quality Certification, a Chapter 91 Waterways License, and an Order of Conditions.

Conveyor System. The Department is currently considering implementation of a conveyor system to move excavated soil from the point of excavation to at least two of the barge loading sites (see Figure 20.8). In East Boston the system would be relatively simple. Trucks would bring the excavated material to the shore of Bird Island Flats and dump it into a conveyor which would load it onto barges. The barge loading area would be located on the west side of the Third Harbor Tunnel crossing area.

20.1.2 Construction Schedule And Sequencing

A carefully phased "fast track" construction program has been developed. This program is based on overlapping design and construction phases, and dividing the work into contract "packages" to permit completion of the project in 9 years. Approximately 85 separate contracts will be awarded in a sequence geared to achieve the project's overall completion schedule. Accordingly, numerous contracts will be in progress at the same time, and the award of certain contracts will be dependent on completion of work by preceding contracts. The sequence of work for the entire project is designed to minimize the magnitude and duration of traffic disruption.

The project construction schedule for each of the six subareas and their respective construction stages is shown on Figure 20.9. Each subarea and construction stage is described in the appendix with more detailed discussion and illustration provided in the Supportive Engineering Report. (The approximate location of construction during each year of the project is shown in Figure 20.10.)

Utility relocations, demolition, and the installation of construction support facilities are scheduled to begin in 1990 for all areas, and heavy construction will start soon thereafter. The South Boston Haul Road will be completed early in order to reduce construction vehicle movements on local streets and minimize traffic disruption during construction of the I-93/I-90 Interchange and the Seaport Access Road. By 1994, the immersed tube tunnel to Logan Airport is scheduled for completion. It will be opened to trucks and high-occupancy vehicles, thus reducing congestion in the I-93 corridor during the second half of the construction period.

Approximately 4 years following completion of the Third Harbor Tunnel, the eastern extension of I-90 from I-93 under Fort Point Channel is scheduled for completion, along with most of the new I-93/I-90 Interchange. During this period, work will also proceed on the new Charles River bridges for I-93. The I-93 portion of the Artery/Tunnel Project is expected to begin carrying traffic in the northbound direction by 1996, and to be operational in both directions by 1997. The entire project is projected for completion, including removal of the existing elevated structure and restoration of surface streets, by the end of 1998.

In addition to the opening of the Third Harbor Tunnel, key project scheduling constraints include the Fort Point Channel crossing and the transition roadway segment between Dewey Square tunnel at Kneeland Street north to the elevated Central Artery. Construction stages for each project subarea are summarized below. A more detailed discussion for each area is provided in the appendix.

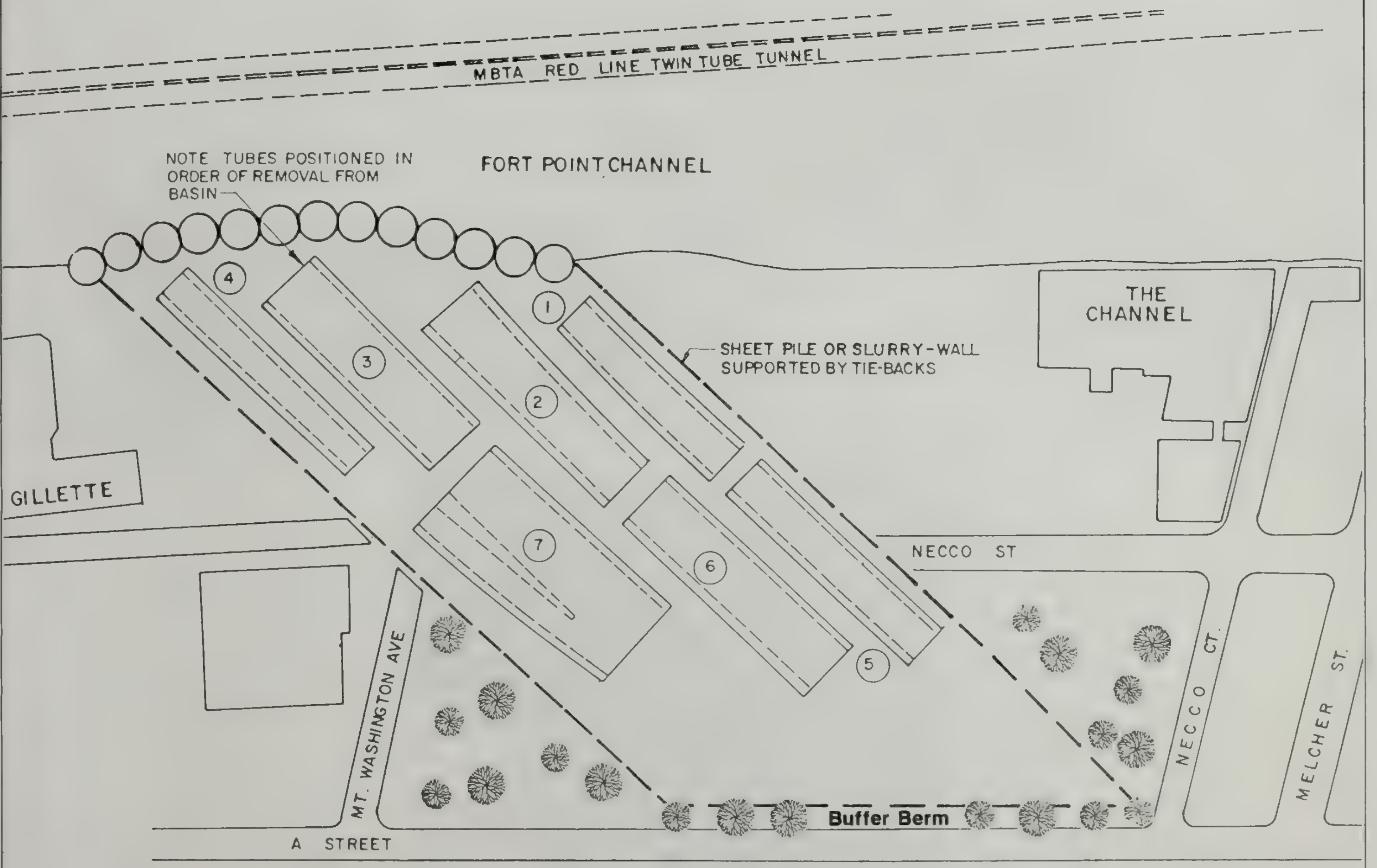
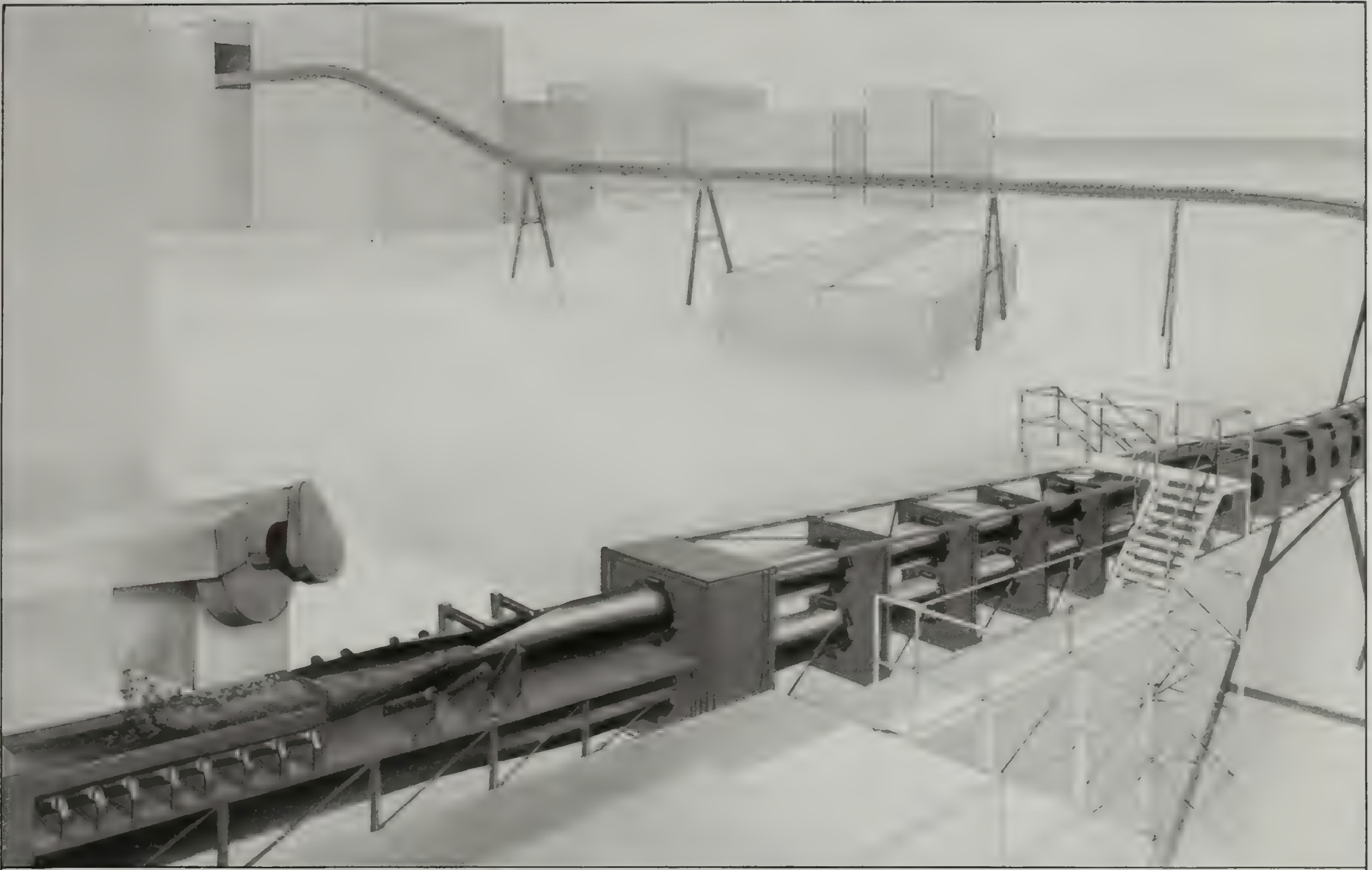

MBTA RED LINE TWIN TUBE TUNNEL
NOTE TUBES POSITIONED IN ORDER OF REMOVAL FROM BASIN
FORT POINT CHANNEL
4
1
3
2
7
6
5
SHEET PILE OR SLURRY-WALL SUPPORTED BY TIE-BACKS
THE CHANNEL
GILLETTE
NECCO ST
MT. WASHINGTON AVE
NECCO CT.
MELCHER ST.
Buffer Berm
A STREET

FIGURE
20.7

Casting Basin

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 50 100 200



Schematic of conveyor system.

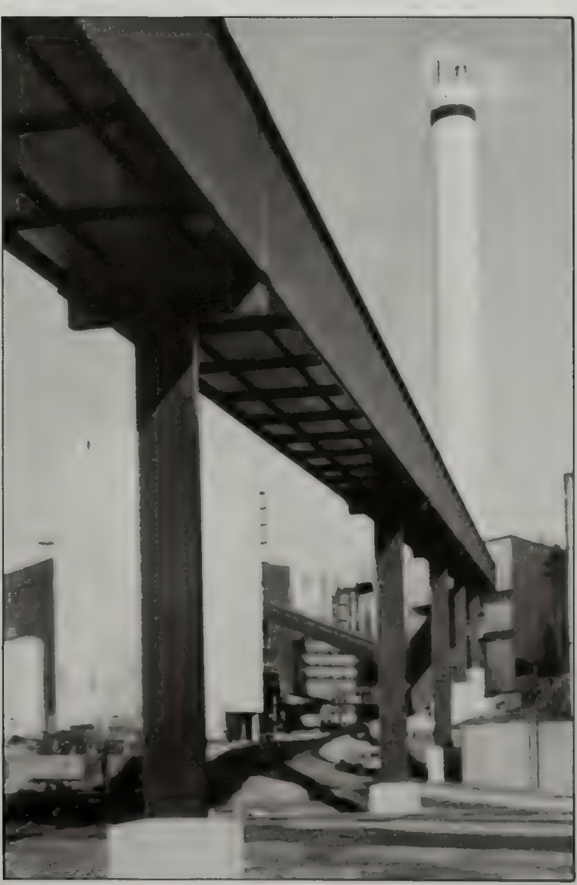


Photo of actual enclosed
conveyor system in operation.

FIGURE

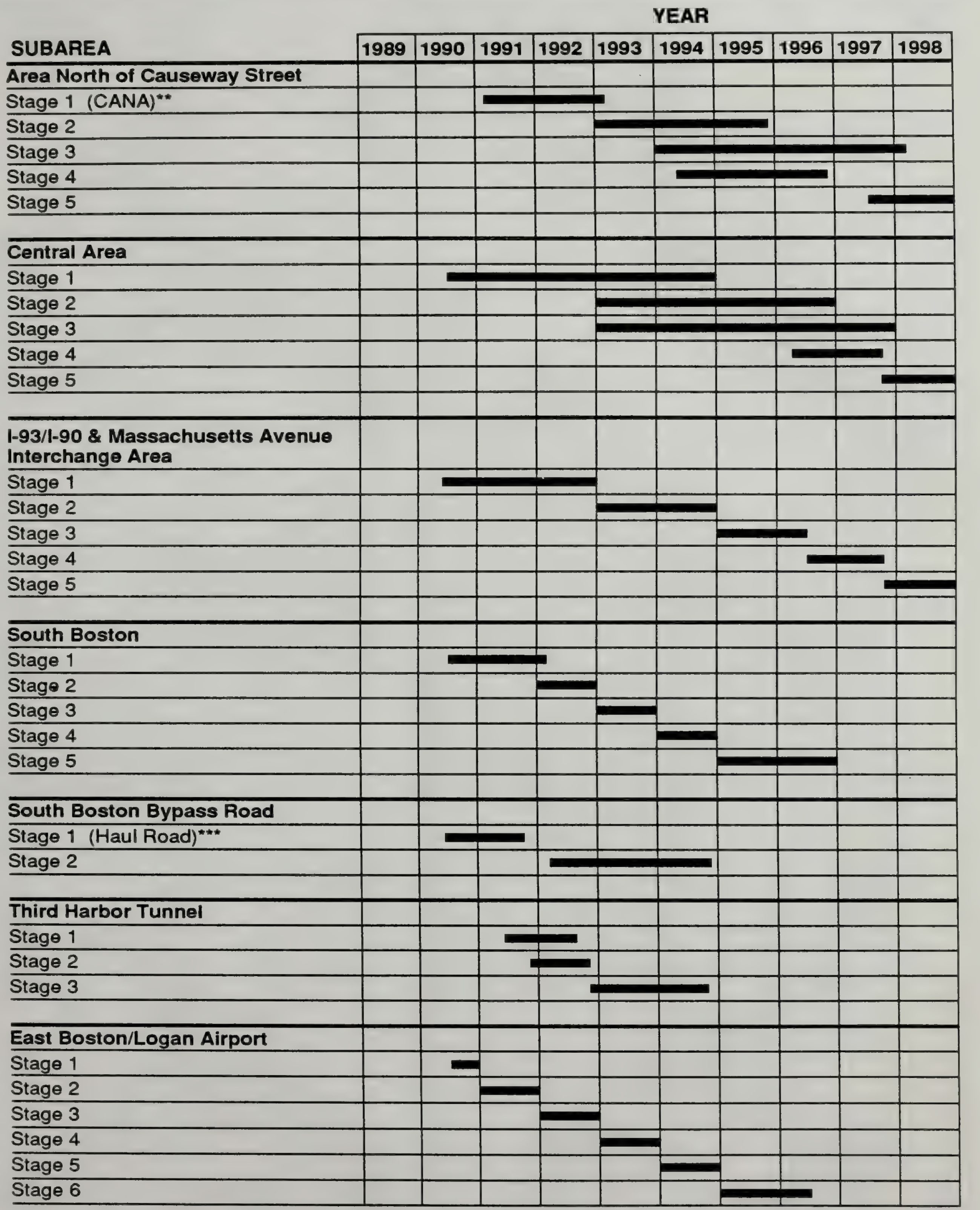
20.8

Conveyor Belt Examples

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Upper photo: Bridgestone Corporation, Tokyo, Japan

Lower photo: PWH, A Member of the PHB Weserhütte Group, Cologne, West Germany



* Construction staging for each subarea is contingent upon final design of roadway and related facilities. Schedule shown is based on The Proposed Action. Durations shown are based on input from Construction Planning Group. Refer to construction staging graphics for details about these stages.

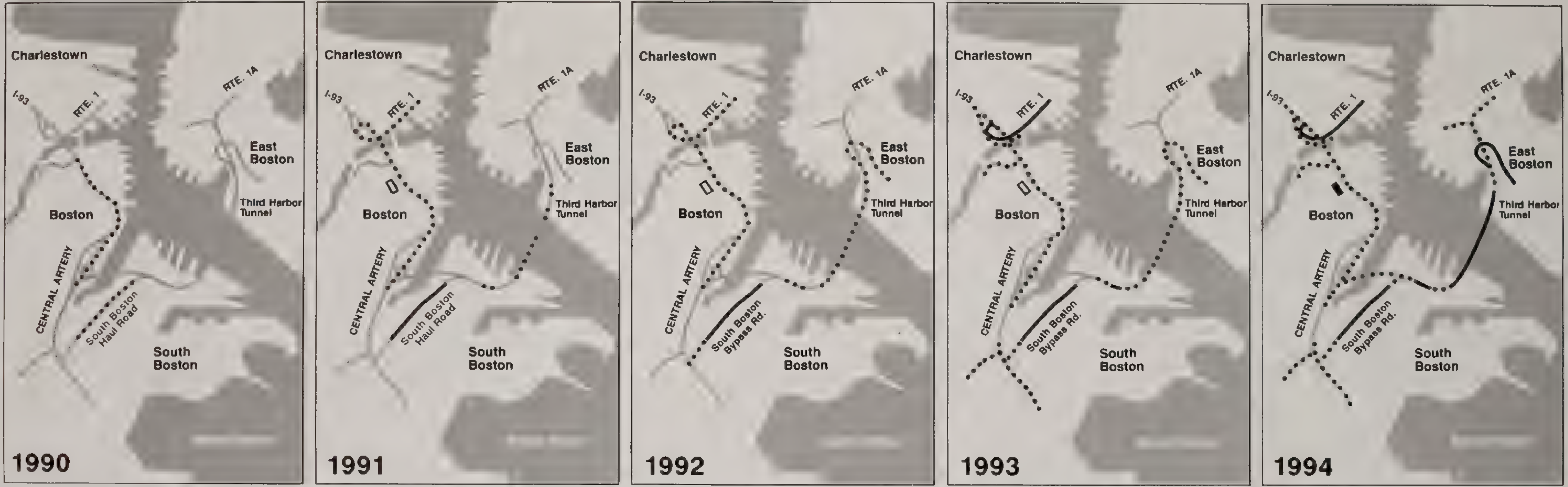
** The Central Artery North Area (CANA) Project is a separate ongoing undertaking by MDPW.

*** The Haul Road is an advance construction traffic mitigation project and a commercial truck route to alleviate longstanding traffic problems in South Boston.

FIGURE 20.9

Project Construction Schedule*

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



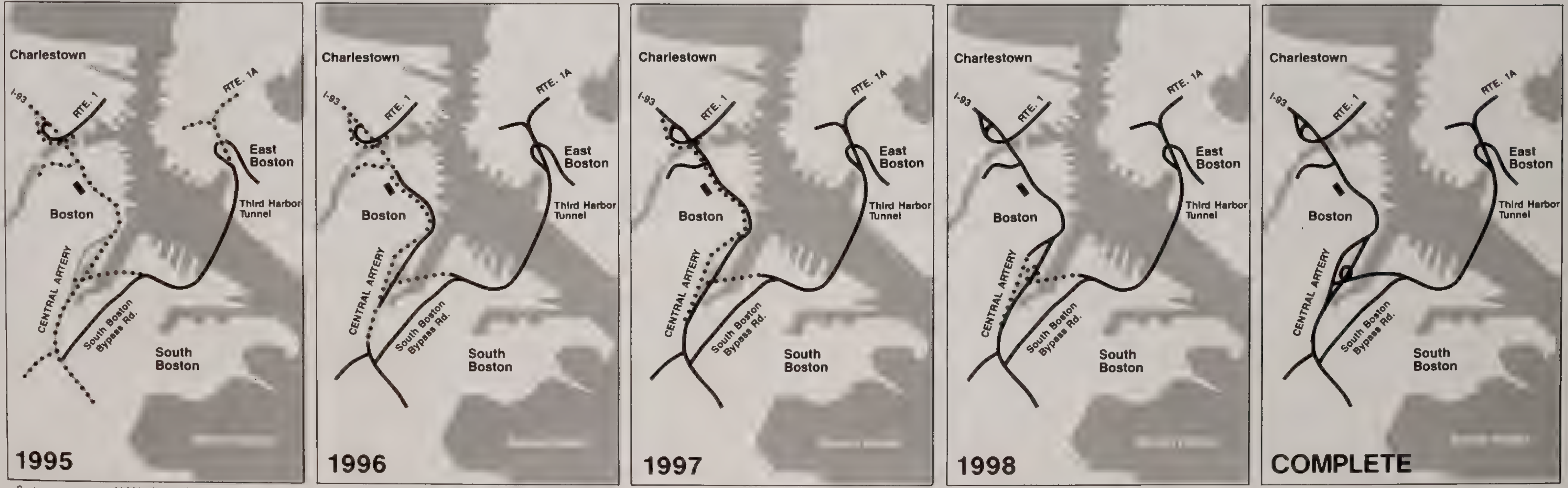
- Begin utility relocations for I 93
- Construct South Boston Haul Road

- Begin construction of the Third Harbor Tunnel and I-90 tunnels in South Boston and East Boston
- Begin construction of N. Causeway as part of the CANA loop connectors
- Continue utility relocations for I-93

- Begin construction of the South Boston Bypass Road
- Continue construction of I-90 tunnels and Third Harbor Tunnel
- Continue utility relocations for I-93
- Complete the CANA loop connections

- Begin construction of I-93 bridges and tunnels in Central Area
- Begin construction of I-93 structures in the South Bay Area
- Continue construction of I-90 tunnels and Third Harbor Tunnel

- Continue construction of I-93 bridges and tunnels in Central Area
- Continue construction of I-90 tunnels
- Continue construction of I-93 structures in the South Bay Area
- Complete construction of the Third Harbor Tunnel



- Continue construction of I-93 bridges and tunnels in Central Area
- Continue construction of I-90 tunnels
- Continue construction of I-93 structures in South Bay Area

- Continue construction of I-93 bridges and tunnels in Central Area
- Continue construction of I-90 tunnels
- Continue construction of I-93 structures in South Bay Area
- Complete I-93 N B Tunnel

- Continue construction of I-90 tunnels
- Continue construction of I-93 structures in South Bay Area
- Complete I-93 S.B. Tunnel

- Complete I-90 tunnels
- Complete I-93 structures
- Complete demolition of the Artery and restoration

LEGEND

•••••• Work In Progress

―― Work Completed During Year

FIGURE 20.10 Construction Sites (By Year)

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

NOT TO SCALE

20.1.2(a) Area North Of Causeway Street

Construction in the Area North of Causeway Street will require careful attention to the continuing operation of major transportation facilities including the Charles River high bridge, North Station commuter railroad trestle bridge, the MBTA Orange Line, and major roadway interchange connections on both sides of the Charles River linking downtown Boston and Leverett Circle with the regional highway network north of Boston. Construction will be phased over approximately 8 years, involving five stages.

20.1.2(b) Central Area

The sequencing of Central Area construction is proposed in five overlapping stages during a 9-year period. Traffic will be maintained during the entire construction period by keeping all six lanes of the existing elevated Central Artery open until corresponding segments of the new underground roadway are ready for operation. In addition to the utilization of special design and construction methods, this will be accomplished by sequencing the work to minimize traffic disruption. Connections to other roadways will receive special attention.

A key scheduling constraint which will affect maintenance of traffic in this area is the new northbound tunnel segment along Atlantic Avenue in the Dewey Square area. This component must be completed, and northbound Central Artery traffic diverted to it, in order to connect and complete the southbound segment of the new roadway through the existing Dewey Square tunnel, while still maintaining traffic flow. The work has been sequenced to complete and open the northbound tunnel first, in order to accommodate this scheduling constraint.

Construction sequencing is planned so that Central Artery ramps can be maintained or replaced with temporary ramps to the maximum extent possible. However, most of the ramps between Congress Street and the Charles River will be replaced during construction. Because of space constraints at certain locations, a few ramps will be taken out of service without a replacement. This is planned at five locations, requiring temporary surface street detours to other ramps. These locations are: the northbound on-ramp from Atlantic Avenue at Northern Avenue; the northbound off-ramp near Northern Avenue; the southbound on-ramp from Causeway Street; the northbound off-ramp to Causeway Street; and the southbound on-ramp from Purchase Street, adjacent to International Place.

All major surface streets, pedestrian walkways, and routes crossing underneath the Central Artery will be maintained throughout the construction period. This will be accomplished by phasing the work across each location, providing temporary detours and traffic shifts, as required, to maintain traffic flow.

20.1.2(c) I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

Construction in this area is proposed to extend in five stages over a 9-year period. The strategy is to complete construction of railroad and roadway facilities located on the periphery of the existing I-93/I-90 Interchange during the early construction stages without disturbing major traffic movements. Mainline and interchange ramp work, including the I-90 extension and Fort Point Channel crossing, will proceed during Stages 2 through 4 toward completion and connection with the Seaport Access Road/Third Harbor Tunnel in Stage 5.

I-93 mainline construction will occur during the same period. The construction north of Randolph Street will concentrate on I-93 northbound and adjacent ramps in the early phases of the work, leading to the opening of the I-93 northbound section beneath Atlantic Avenue at the beginning of Stage 4. The remaining work on the I-93/I-90 Interchange viaducts will follow the opening of this I-93 northbound section. I-93 south of Randolph Street including the Massachusetts Avenue connector will be largely constructed in Stages 2 and 3. Construction has been phased and sequenced to maintain uninterrupted commuter railroad service to South Station, freight operations in the South Boston area, through traffic on the two major expressways, and the numerous connecting service roads and local streets.

20.1.2(d) South Boston And South Boston Haul Road/Bypass Road

Construction in this area is planned in five stages over approximately an 8-year period. During all of these stages, Summer and Congress Streets will remain open, and traffic will be maintained on surface streets and on railroad lines affected by the project. The relocated Massport Haul Road and a new South Boston Haul Road will carry construction vehicles. This will be accomplished through the use of temporary detours, decking over the construction area at cross streets (such as Massport Haul Road, Northern Avenue, and A Street), relocation of the Massport Haul Road, and the relocation of the Conrail tracks.

Haul Road construction will involve a two-lane limited-access roadway. The Haul Road is an advance construction traffic mitigation measure designed to carry project-related trucks in the South Boston area, between Dorchester Avenue and Congress Street, thus avoiding local streets. (This early action project is described in a separate SEIS/R document.)

During the time period required to complete the Third Harbor Tunnel crossing, the extension of the Haul Road from Dorchester Avenue to the I-93 Frontage Road will also be built creating the South Boston Bypass Road. This facility will allow restricted traffic (trucks and buses) to reach Logan Airport from I-93 via the Bypass Road into South Boston and the Third Harbor Tunnel.

20.1.2(e) Third Harbor Tunnel

Construction of the immersed Third Harbor Tunnel is planned in three stages over a 3-year period. The binocular steel shell tube sections can be constructed in dry docks or shipways, launched, and floated to the site. This off-site fabrication, towing, and outfitting the interior and exterior with concrete will be coordinated, such that the tube sections are ready for placement when the trench is ready to accept them. This is especially important at the BMIP pier where construction activities will temporarily occupy approximately 11 acres used to store and process imported automobiles. The work is estimated to take approximately 16 months from the time pier excavation begins to the time when the first immersed tube sections are placed, the area backfilled, and the surface restored to its existing condition.

20.1.2(f) East Boston/Logan Airport Area

Construction in this area is planned in six general stages over approximately a 6-year period. Numerous detours will be required, since many of the new facilities will be built in areas occupied by existing roadways. The Bird Island Flats tunnel section and airport ramp connections to and from the airport will be completed first, in tandem with South Boston/Third Harbor Tunnel construction. This will allow early opening of an alternative airport access route from downtown Boston, while reducing traffic volumes on the existing airport access corridor. The latter actions will have a positive effect on maintenance of traffic during completion of the remaining I-90 elevated mainline and ramp connections to Route 1A.

20.1.3 Construction Management

Construction management planning combines the technical and practical knowledge and understanding obtained on previous projects of similar magnitude and complexity, performed in other cities throughout the country and the world, with the specific knowledge of local conditions and concerns unique to this project and the Boston metropolitan region. Recent examples include the Red and Orange Lines, and Southeast Expressway Projects. The planning proceeds through several stages, beginning with preliminary design and environmental studies and continuing through final design and construction.

20.1.3(a) Preliminary Engineering/Supplemental Environmental Impact Assessment

During the early planning and preliminary design phase of the project, construction management planning is concentrated in the areas of identifying construction methods, development of a contract packaging strategy, development of construction management procedures, material and resources planning, and development of strategies to mitigate the impacts of construction on the environment and the community. Much of the preliminary construction management planning effort has already been accomplished and is described in this chapter and throughout the SEIS/R.

Interaction between the project planners and the community has been an essential part of this process. Hundreds of meetings with numerous community groups, abutters, businesses, and others have led to an understanding of the issues and concerns which must be incorporated into the development and implementation of the Construction Management Plan and Mitigation Program.

For example, plans for maintaining the existing elevated Central Artery in full operation, and for removing excavated material by barge and via the South Boston Haul Road, are already a part of the project. These measures help ensure access to downtown Boston, and enable a reduction of construction traffic on City streets. Construction staging for each major subarea, including major construction activities and traffic detours, have been outlined and assessed to minimize disruption and to facilitate uninterrupted traffic flow to the extent practicable. This process of interactive construction and mitigation planning with the community is not completed with the drafting of the SEIS/R, but is actually just beginning to move into the second and more detailed phase, which occurs during final engineering design.

20.1.3(b) Final Design

During final engineering, more than 30 section design consultant (SDC) contracts will be awarded to various architectural/engineering (A/E) firms to carry the design from the preliminary (approximately 25 percent) completion level to the final (100 percent) completion level. (The locations of these design contracts are shown in Figure 20.11.) As the design develops, site-specific design requirements and construction issues, traffic controls, and mitigation requirements will come into greater focus. A primary function of the construction management effort during this phase will be to make sure that the input and knowledge obtained from those impacted by the project regarding their general and site-specific concerns are passed on to the SDCs for incorporation into the design documents.

A number of site-specific issues must be addressed and resolved with the affected parties during this process. These issues will include:

- maintenance of access to buildings by vehicles and pedestrians
- maintenance of local street access and emergency access
- noise and vibration control during day and night shift operations
- coordination with building owners and tenants of utility service shiftovers to new service
- other site-specific issues related to the functioning or operation of adjacent facilities

In conjunction with the Mitigation Program Office described below, construction management will interact with various impacted groups (including building owners, tenants, community groups, public agencies, and the SDCs). The needed requirements and restrictions that govern the manner in which the contractor may perform the work will be identified and incorporated into the design documents.

The site-specific and general concerns raised at these meetings will be, to the extent possible, translated into specific provisions that will be incorporated into the construction contracts developed by the SDCs. Once defined in the construction contract, these provisions become enforceable requirements that the construction contractors must comply with.

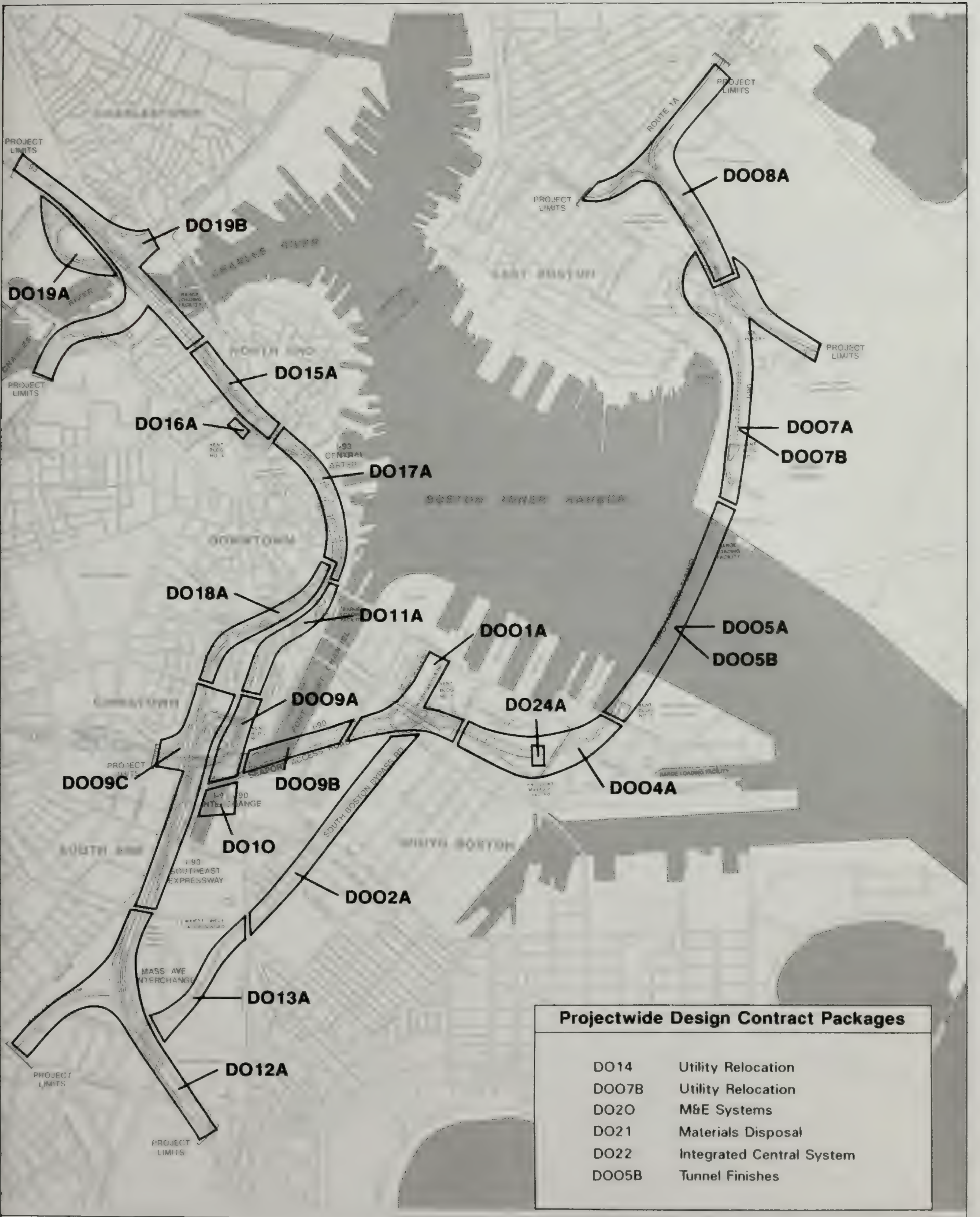
In addition to coordinating with SDCs on construction mitigation issues, construction management will perform constructibility reviews of design documents throughout their development. The objective of these reviews will be to provide recommendations to the SDCs that can result in the most economical and cost-effective design attainable, schedule savings, and construction-contractor claim avoidance.

20.1.3(c) Construction

Effective construction management provides the techniques to monitor the activities of the contractors and perform the ancillary technical functions that provide a positive control over projects, no matter how large or complex. Key activities performed by the construction management organization to control the work during construction include:

- Contract administration
- Scheduling
- Cost control
- Quality control and compliance
- Reporting
- Coordination with community groups, abutters, and interagency organizations

Figures 20.12 and 20.13 illustrate how the construction management team will be organized and structured to carry out these functions. Construction contracts awarded by the Department will be managed for the Department by a management consultant. By having a management consultant administer the construction program, experts on similar major underground projects in urban areas will be available to directly impart their knowledge and experience to the project for beneficial results. (Figure 20.12 shows the management

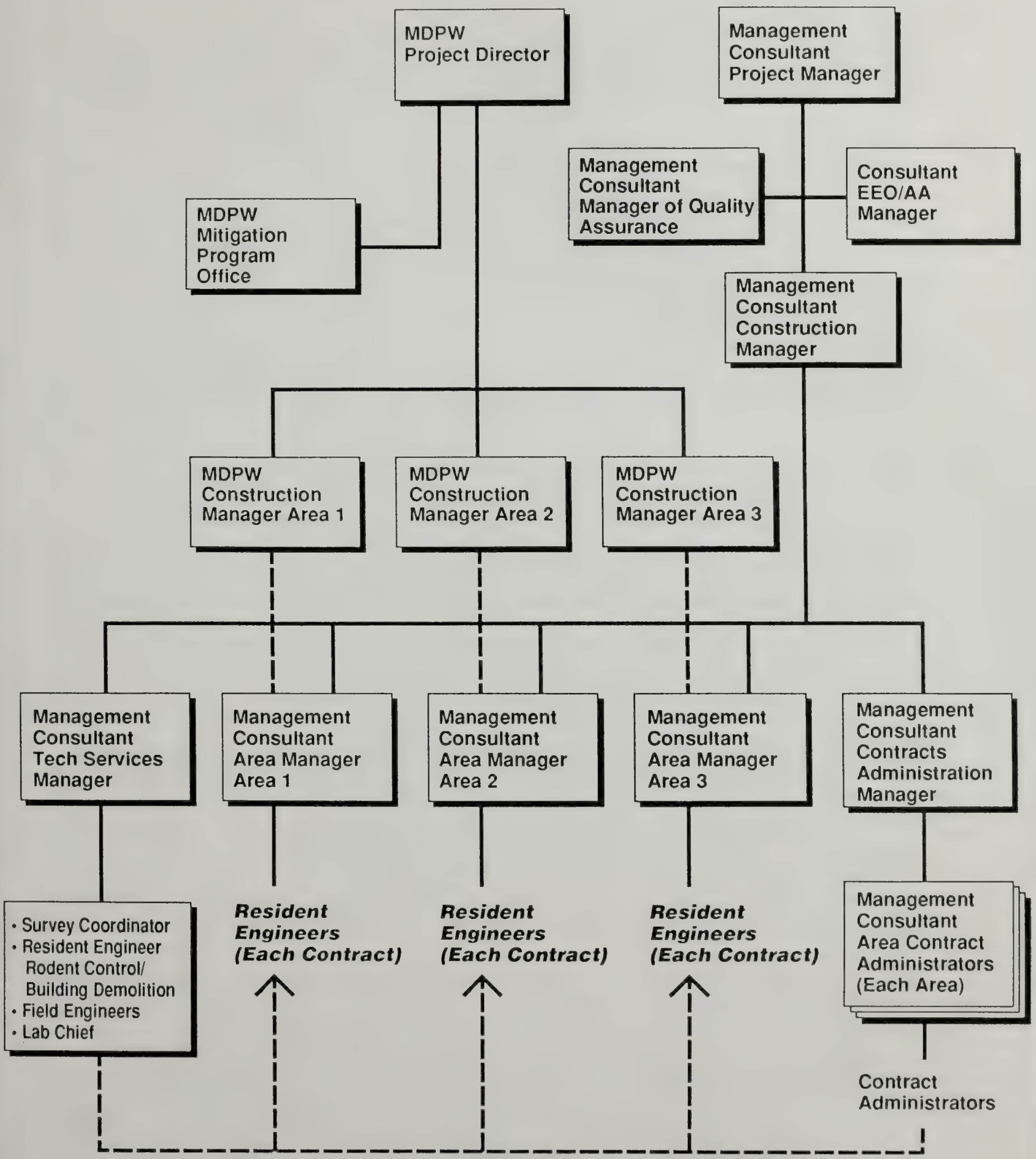


Projectwide Design Contract Packages

DO14	Utility Relocation
DOO7B	Utility Relocation
DO20	M&E Systems
DO21	Materials Disposal
DO22	Integrated Central System
DOO5B	Tunnel Finishes

FIGURE 20.11 **Design Contract Packages**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R


MDPW Project Director
Management Consultant Project Manager
Management Consultant Manager of Quality Assurance
Consultant EEO/AA Manager
MDPW Mitigation Program Office
Management Consultant Construction Manager
MDPW Construction Manager Area 1
MDPW Construction Manager Area 2
MDPW Construction Manager Area 3
Management Consultant Tech Services Manager
Management Consultant Area Manager Area 1
Management Consultant Area Manager Area 2
Management Consultant Area Manager Area 3
Management Consultant Contracts Administration Manager
• Survey Coordinator
• Resident Engineer Rodent Control/ Building Demolition
• Field Engineers
• Lab Chief
Resident Engineers (Each Contract)
Resident Engineers (Each Contract)
Resident Engineers (Each Contract)
Management Consultant Area Contract Administrators (Each Area)
Contract Administrators

FIGURE

20.12 **Construction Management Organization**

organization, including the interface between the Department and a management consultant, and the principal levels of management responsibility: the project director and manager, construction manager, area managers, and resident engineers.) This is consistent with management structures on other major projects.

The Department's recent experience on both the Southeast Expressway Project and the CANA project demonstrates the value of placing responsibility for the identification and implementation of construction mitigation measures in a separate office whose sole responsibility is to assure that the impacts of construction are mitigated to the maximum extent possible. This office will be proactive, properly staffed, and have access to appropriate decision makers to facilitate the timely and efficient implementation of mitigation measures. It is intended that the construction mitigation program, described in this chapter and the appendices, will be established and administered as a separate element of the management structure to assure its independence. To that end, the Department has created a Mitigation Program Office, reporting directly to the Project Director for the Department.

Figure 20.13 focuses on the key responsibilities of the construction management team within each construction area which are critical to minimizing temporary disruption and maximizing the effectiveness of mitigation efforts. Central to the organizational structure is the resident engineer assigned to each construction contract and serving as the Department's authorized representative for the contract. The resident engineer's responsibilities include monitoring the work for compliance with the plans and specifications and administration of the terms and conditions of the contract. The resident engineer will be located at the construction site and will have the responsibility to oversee all of the construction management functions on the contract(s) assigned by coordinating the services of the various support entities and the support staff assigned to the contract.

The resident engineer reports to the area manager. Area managers are responsible for the coordination of specific contracts in a geographic area or of a general nature. The project will be divided into as many as three general sections, each with an area manager assigned: (1) East Boston, South Boston, and Third Harbor Tunnel; (2) I-93/I-90 Interchange; and (3) Central Artery. In addition, a fourth area for projectwide contracts, such as mechanical and electrical systems, may be required. The area manager's primary responsibility is to coordinate all construction work between the various active contracts in the area, focusing particularly on interface points where two active contracts are adjacent to each other.

The area managers report to the construction manager. The construction manager and staff are responsible for all construction contract administration and construction activities on the project. Their efforts are directed toward the efficient and expeditious completion of the work. The construction manager, the project manager, and the Department management staff will interface regularly on all matters related to the successful completion of the project.

The Department will have a counterpart management level organization that interfaces directly with the management consultant's organization on the administration of key elements of the construction contracts. Matters involving changes in the substance of the contract (such as changes in the scope of work, cost, or schedule) will require approval of designated Department representatives prior to implementation. Construction managers, paralleling the management consultant's area managers, will be assigned by the Department to provide this overview and approval authority. Finally, as described earlier, a Mitigation Program Office has been established.

Throughout the construction period, frequent coordination with local community groups, individual abutters, and various interagency organizations will be arranged through the project's community participation and mitigation program groups to assure that the needs and interests of impacted parties are being adequately addressed. Specific meetings to discuss detailed work plans and procedures will be arranged by the Construction Management Team with the Mitigation Program Office and conducted between the contractor and the impacted group or individual, as required. Whenever practicable, the contractor will be required to utilize work methods and schedules that incorporate the legitimate concerns of the impacted parties and minimize disruption. Critical operations, such as utility service curtailments or short-term access restrictions, will be scheduled to best accommodate the specific needs of the impacted individuals or groups.

20.2 IMPACTS DURING CONSTRUCTION

20.2.1 Traffic And Transportation

This section identifies both the systemwide and local area effects that the Proposed Action may have on transportation facilities and services. Other important transportation concerns are also discussed, including: pedestrian circulation, public transportation, and navigation.

20.2.1(a) Systemwide Effects On Traffic

Construction of the Proposed Action will have temporary effects on the regional highway and railroad network, and the local street system. Some of these effects, both positive and negative, will influence levels of service provided by different modes. The major effects are expected to involve peak period commuter travel to and from downtown Boston, and the alternate routes and services associated with commuter travel. Other effects include suburban communities and areas adjacent to downtown Boston which may be sites for logistical support for the project (for example, storage of materials or remote employee parking), or could be affected by systemwide mitigation measures, such as increased parking at transit and commuter rail stations, new rail cars, and improved frequency of service. None of these effects is expected to result in deterioration of regional air quality levels. Conversely, the systemwide mitigation and maintenance of traffic measures already incorporated in the project design, and currently being implemented as a matter of public policy, should result in positive effects on regional air quality.

Commuter Travel. Commuter travel on the major highway access routes to downtown Boston and the Central Artery was described in Chapter 3. Bottlenecks and other sources of congestion affecting traffic flows, including peak hour queues and delays on specific expressway facilities, were identified. If no measures are taken to mitigate known negative traffic conditions resulting from project construction, such as detours, temporary lane constrictions, and ramp closings, these conditions could worsen.

Hypothetically, if no measures were to be taken to assist commuters and maintain traffic flow, added delay on highway access routes might shift commuters to alternate routes,

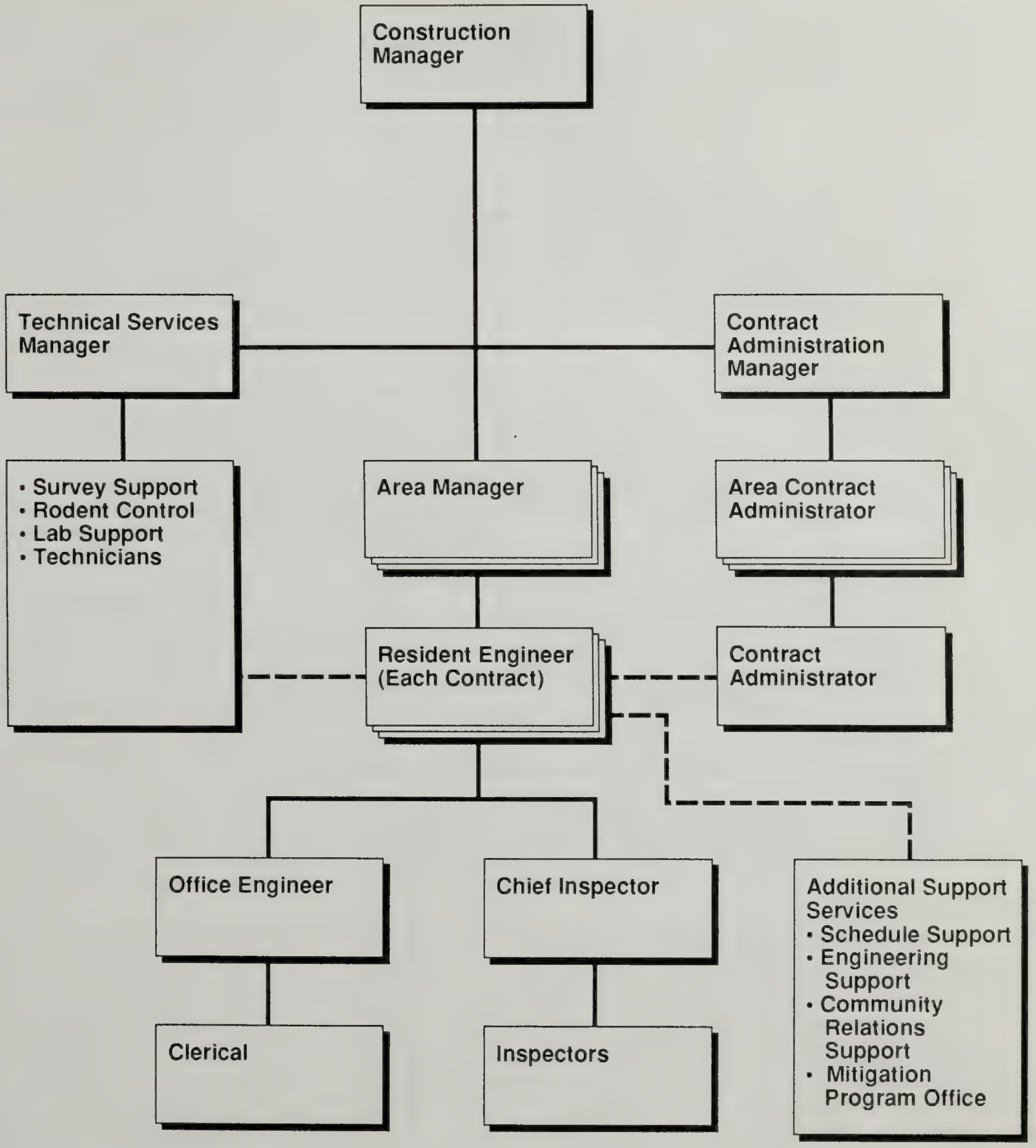

Construction Manager
Technical Services Manager
Contract Administration Manager
• Survey Support
• Rodent Control
• Lab Support
• Technicians
Area Manager
Area Contract Administrator
Resident Engineer (Each Contract)
Contract Administrator
Office Engineer
Chief Inspector
Additional Support Services
• Schedule Support
• Engineering Support
• Community Relations Support
• Mitigation Program Office
Clerical
Inspectors

FIGURE
20.13 Construction Management Organization Management Consultant

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

especially parallel local streets to downtown, creating problems on these facilities. Some commuters would change their mode of travel, most likely to subway, commuter rail, or ferry lines, whichever most closely replicates their current travel pattern, possibly straining the capacity of their public transportation facilities and services as well. Others might choose to join carpool or vanpool programs.

These potential effects have been anticipated, and a systemwide maintenance of traffic program has already been initiated to identify and mitigate the negative consequences, as described later in this chapter. While some disruption to highway commuter travel will occur, especially during the early to mid-years of the project, the mitigation program will insure, that travel to downtown Boston will be much as it is today for the duration of the construction period.

Parking. One of the unresolved issues in the 1985 FEIS/R was the identification of replacement parking sites. The approach developed to address this issue takes into consideration the type of parking affected (public or private owners), and whether the impact is permanent or interim. (Permanently affected spaces are those which are not returned following construction. Interim impacts are at those areas where parking can be restored once construction in the area is complete.)

The overall parking program, for the Artery/Tunnel Project, described in more detail in the appendix, will result in no net increase in the number of downtown parking spaces. Approximately 3,690 parking spaces will be permanently displaced projectwide. Of the spaces lost 810 are in the Area North of Causeway Street, 940 are in the Central Area, 470 are in the South Bay interchange, 940 are in South Boston, and 530 are in East Boston.

Most of these spaces are on lots owned by private and quasi-private entities, for which parking provides support for business activities, entities who operate parking lots as commercial ventures, and agencies of government, for which parking provides support for operations. A small number of spaces are on City streets and used for parking vehicles owned by customers and establishments serving local business.

Construction activities will result in the temporary removal of additional parking for a term of 1 to 8 years, affecting an average of 2,320 spaces per year. The impact will be greatest in the fifth year of the project, when an estimated 4,760 spaces will be temporarily unavailable for use, and least in the first year of the project, when 760 spaces will be unavailable. Of the various types of parking, commercial parking will be the most widely affected. During any one year of construction, impacts to commercial spaces will average 32 percent of the impacted spaces.

The project subarea which will experience the most extensive impacts to parking is South Boston. Average yearly impact in this area will be 1,570 spaces. The other subareas will experience substantial impacts but for shorter periods. In the Area North of Causeway Street/Central Area an average of 820 spaces will be affected each year of construction. During years through 8 impacts will be more substantial. An average of 1,110 spaces will be lost during each of these years. The impact to parking in the South Bay area will be particularly high years 3 through 7, 670 spaces per year on average. The largest impact in East Boston will occur during years 4 through 8 when a yearly average of 960 spaces will be affected.

Other Effects. The project will include several remote material storage areas which may contribute to the traffic flow on major routes between these sites and the project area. To the extent that these sites are accessible to rail freight lines, they will help mitigate systemwide traffic impacts.

Also, some suburban communities have raised a concern that increased parking at commuter rail and subway stations attributable to the project could cause local traffic circulation problems. These fears, whether real or imagined, must be weighed against the overall systemwide benefits of increased public transportation for the project, the region, and the local areas themselves.

20.2.1(b) Local Area Effects On Traffic

Each local area will encounter different traffic and transportation conditions during construction, including temporary detours and diversions, parking, delivery and removal of construction materials, and provisions for contractors and employees. (Each of these conditions is discussed for the six project subareas in the Maintenance of Traffic Plan Appendix. A summary of the traffic conditions where mitigation measures may be necessary is provided here. The information contained in this section is subject to change as final design proceeds on the project.)

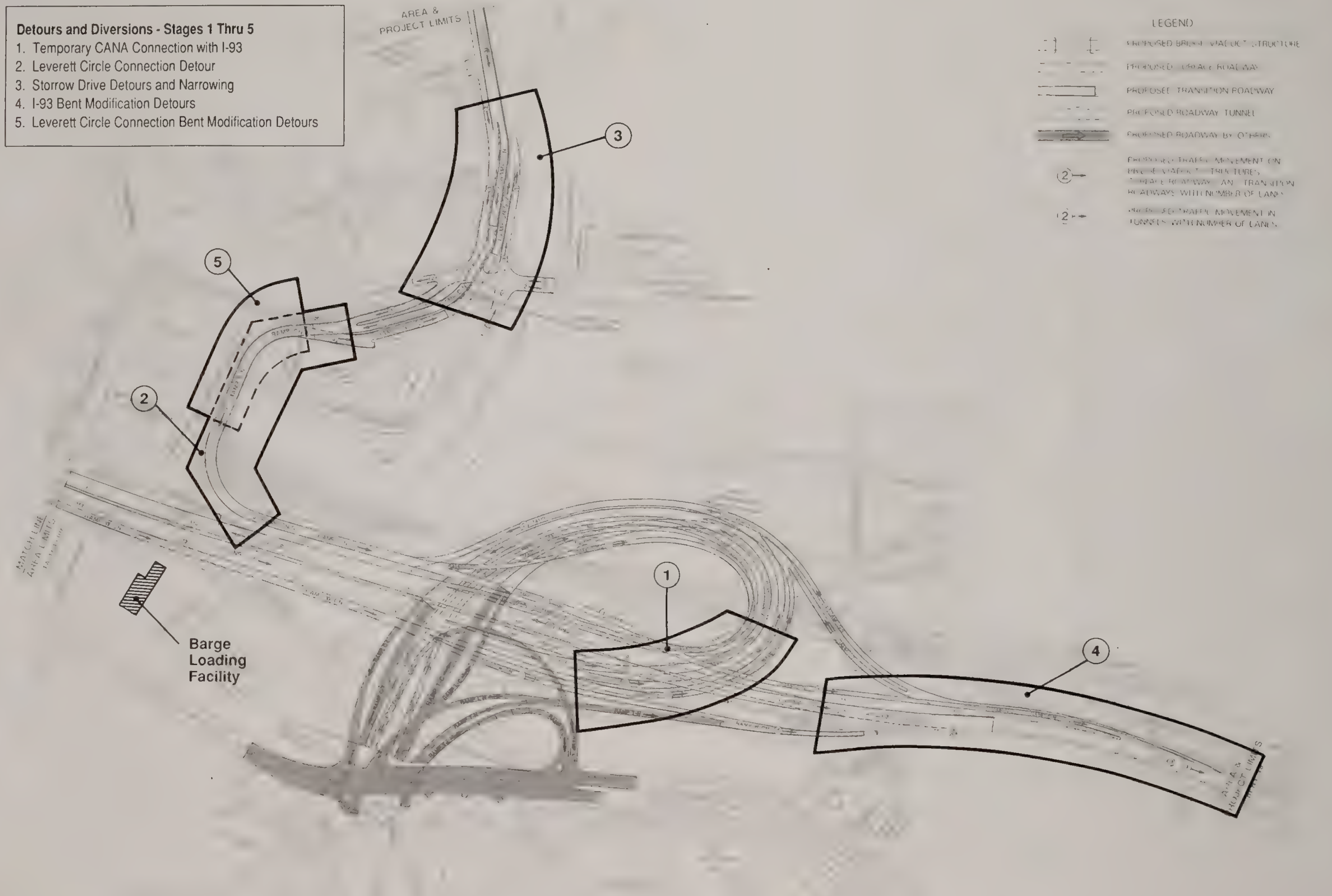
Area North Of Causeway Street. The primary detours and maintenance of traffic considerations in this area involve traffic on I-93 and I-93 connector ramps to Storrow Drive and Route 1 in Charlestown (see Figure 20.14). There are few surface streets north of Causeway Street that could be affected by construction. Minor traffic disruptions during off-peak periods may occur during interim relocations of Nashua Street during viaduct modification work and North Station garage construction, and on New Rutherford Avenue during construction of new surface ramp connections to Route 1. The present number of travel lanes will be maintained on local streets. Traffic flow on all surface streets in the area will be continuously maintained throughout the construction period.

Movement Of Construction Materials: Excavation in this area will be limited to pier footings, marine excavation for the river crossing bridge piers, excavation work for the bridge approach segments north of Causeway Street, and excavation for the new underpass below Leverett Circle. Total excavation is expected to generate approximately 135,000 cubic yards, largely from the bridge approach section and new underpass. This relatively small volume of material will be disposed of either by trucking it to a landfill via I-93 or by loading it on barges for transport to Spectacle Island. If it is decided to transport this material to Spectacle Island a temporary barge loading facility would be constructed on the north bank of the Charles River.

Material excavated for the river crossing support will be loaded directly into barges, and transported through the MDC dam locks to the marine disposal site.

Construction in this subarea will also require the demolition and removal of debris from the Anelex building at 150 Causeway Street. This 13-story reinforced concrete structure will generate approximately 1,000 truckloads of debris. This material will be trucked to a reclaim area in South Boston as described in 20.1.1(f).

Approximately 100,000 cubic yards of concrete will be required for bridge footings, piers, deck surfaces, approach slabs, and bridge abutments in the Area North of Causeway Street.


AREA & PROJECT LIMITS
MATCH LINE AREA LIMITS
Barge Loading Facility
1
2
3
4
5
AREA & PROJECT LIMITS
LEGEND
PROPOSED BRIDGE VIADUCT STRUCTURE
PROPOSED SURFACE ROADWAY
PROPOSED TRANSITION ROADWAY
PROPOSED ROADWAY TUNNEL
PROPOSED ROADWAY BY OTHERS
② PROPOSED TRAFFIC MOVEMENT ON BRIDGE VIADUCT STRUCTURES, SURFACE ROADWAY AND TRANSITION ROADWAYS WITH NUMBER OF LANES
2 PROPOSED TRAFFIC MOVEMENT IN TUNNELS WITH NUMBER OF LANES

Detours and Diversions - Stages 1 Thru 5

1. Temporary CANA Connection with I-93
2. Leverett Circle Connection Detour
3. Storrow Drive Detours and Narrowing
4. I-93 Bent Modification Detours
5. Leverett Circle Connection Bent Modification Detours

FIGURE 20.14 **Detours And Diversions - Stages 1 Thru 5**
Area North Of Causeway Street

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Concrete demand will be spread out over a 4-year construction period, and peak truck volumes will generally not exceed 20 to 26 truck trips per day in each direction (three to four two-way trips per hour). The area is accessible by several existing ready-mix concrete suppliers. The primary route for concrete deliveries will be from the north using either surface streets or I-93. This level of trucking activity should have little effect on surface street traffic conditions.

Viaduct construction may require the delivery of numerous long-span box girder segments. The construction contractor will have three options for delivering the spans to the site: truck, rail, or barge. The rail and barge options depend on the location of the fabrication site. If the contractor elects to deliver the spans by truck, a route that allows extra-long loads will have to be predetermined to assure sufficient turning radius for truck maneuvering. Deliveries will be arranged for off-peak hours in order to minimize traffic impacts.

The logistics of the material deliveries for the main Charles River crossing spans will depend on the bridge type selected, and the successful contractor's erection procedure. If a concrete segmental or cable-stayed bridge is selected, the bridge will be comprised of numerous 10- to 20-foot concrete segments, which will most probably be delivered and erected by barge, although truck or rail deliveries are also feasible. Other bridge types under study include precast concrete girders, steel stringers, steel box beams, and steel trusses. These bridges can be erected from barges or from land using previously constructed bridge segments as a base.

Area North of Causeway Street bridge and viaduct construction will require approximately 90,000 cubic yards of structural backfill, engineered fill, and embankment fill material. This material will most likely be trucked to the site from commercial sources to the north or west. Demand for this material will be spread over most of the 4-year construction phase, and will require from 10 to 15 truckloads per day (one to two two-way trips per hour). Little effect on surface street traffic conditions is anticipated.

During the final phase of construction, the existing I-93 roadway, including the existing Charles River high bridge and a portion of the viaduct structure to the Storrow Drive/Leverett Circle area, will be taken down. The steel from the structure will be cut into manageable segments and removed from the area by either rail, truck, or barge. These activities are expected to generate 10 to 15 truck trips per day with little effect on surface street traffic conditions. Other debris, including the concrete deck and pier structures, will be trucked to a reclaim area in South Boston.

Construction Work Areas: The primary contractor work areas for construction between Causeway Street and the south bank of the Charles River will be located on land currently owned by the Department and used for parking by people who work in the Anelex building. This site of approximately 2.5 acres has been acquired by the project and will be used as a construction area in support of the new Boston Garden development and, later, for Artery construction. A portion of the land owned by the Massachusetts General Hospital Corporation currently used for parking may also be required for contractor use during certain phases of construction in this area.

North of the Charles River, there are several areas that will be available to contractors, including the area inside the CANA loop ramps and adjacent to the rail lines into North

Station; the area west of the existing I-93 viaduct, east of the Millers River, and north of the Charles River; and portions of the area between the existing I-93 viaduct and New Rutherford Avenue, south of the Gilmore Bridge. Additional properties are available north of the Gilmore Bridge, including the Guilford property described in more detail in the following section on Construction Work Areas.

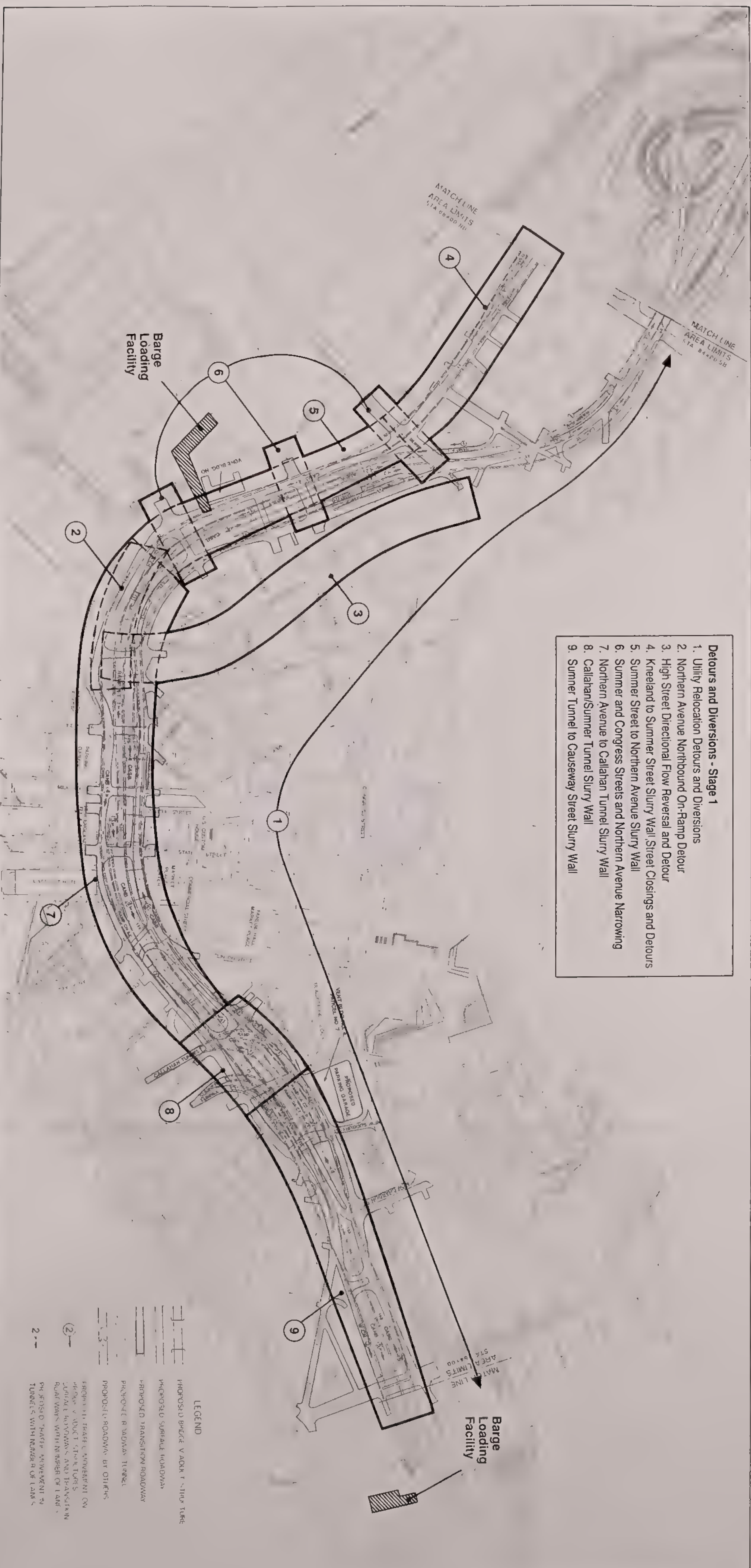
Central Area. Even with the most innovative construction sequencing, methods, and equipment, localized temporary traffic disruption on the Central and Surface Arteries will occur throughout the Central Area during the construction period, much as it does today. The 23 traffic detour and diversion conditions described in the Maintenance of Traffic Plan appendix (see Figures 20.15, 20.16, and 20.17) identify where, when, and to what extent existing traffic conditions are likely to be altered by project construction activities. Measures to mitigate the most severe temporary disruptions are discussed, and will be developed further as a part of the Maintenance of Traffic Plan.

Movement Of Construction Materials: The largest volume of material to be moved will be approximately 3.0 million cubic yards of excavated material that will be transported to the two barge loading facilities in the Central Area. Based on studies of alternative methods of transporting excavated materials, including use of slurry pipelines, rail cars, trucking, and conveyors, trucking was found to be the most viable. However, a conveyor system, combined with vertical lift and material sizers, is being evaluated and could be used in the Central Area as a mitigation measure.

Assuming all excavated material is removed by trucks, hauling would be conducted during the daytime shift from 7:00 AM to 3:30 PM; however, a second and third shift will be utilized when necessary to maintain schedule. Second shift hours are generally from 4:00 PM to 12:00 midnight and third from 12:00 midnight to 7:00 AM. Other work performed on the second and third shifts could include installation of the excavation support system, artery underpinning, utility work, form work and reinforcing steel installation, and completion of concrete placements. To the extent possible work will be conducted below decking or will be done to mitigate the impact of particular phases of construction, such as a street closure or work in front of a building access point. When second and third shift operations are necessary, they will be conducted in compliance with applicable City ordinances governing noise and vibration restrictions.

The two barge loading facilities will be constructed in time to support the mainline construction work; however, these facilities will not be operational during the early utility work and Parcel 7 parking garage work anticipated in 1990 through 1992. The quantities of excavation generated by this early work will be minor, generally not exceeding 20 truckloads per day. Two options are available for the disposal of this material: disposing at approved upland disposal sites, or (by late 1991) trucking to the first of the four barge loading sites to be operational at Dry Dock #3 in South Boston.

During mainline construction, all excavated material removed from the Central Area construction north of North Street will be hauled to the barge loading facility on the Charles River, between the Charles River high bridge and the Charlestown bridge. Trucks will travel through the present parking lot area directly under the existing viaduct structure. During the early phases of the slurry wall construction, Artery underpinning, and deck beam installation work, the trucks will travel across the existing cross streets at


MATCH LINE
AREA LIMITS
Barge Loading Facility
Barge Loading Facility
1
2
3
4
5
6
7
8
9
PROPOSED PARKING GARAGE
CALLAHAN TUNNEL
LEGEND
PROPOSED BRIDGE V ADUCT STRUCTURE
PROPOSED SURFACE ROADWAY
PROPOSED TRANSITION ROADWAY
PROPOSED ROADWAY TUNNEL
PROPOSED ROADWAY BY OTHERS
PROPOSED TRAFFIC MOVEMENT ON PROPOSED VIADUCT STRUCTURES SURFACE ROADWAYS AND TRANSITION ROADWAYS WITH NUMBER OF LANES
PROPOSED TRAFFIC MOVEMENT IN TUNNELS WITH NUMBER OF LANES
FEET

Detours and Diversions - Stage 1

1. Utility Relocation Detours and Diversions
2. Northern Avenue Northbound On-Ramp Detour
3. High Street Directional Flow Reversal and Detour
4. Kneeland to Summer Street Slurry Wall, Street Closings and Detours
5. Summer Street to Northern Avenue Slurry Wall
6. Summer and Congress Streets and Northern Avenue Narrowing
7. Northern Avenue to Callahan Tunnel Slurry Wall
8. Callahan/Sumner Tunnel Slurry Wall
9. Sumner Tunnel to Causeway Street Slurry Wall

FIGURE
20.15

Detours And Diversions - Stage 1
Central Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

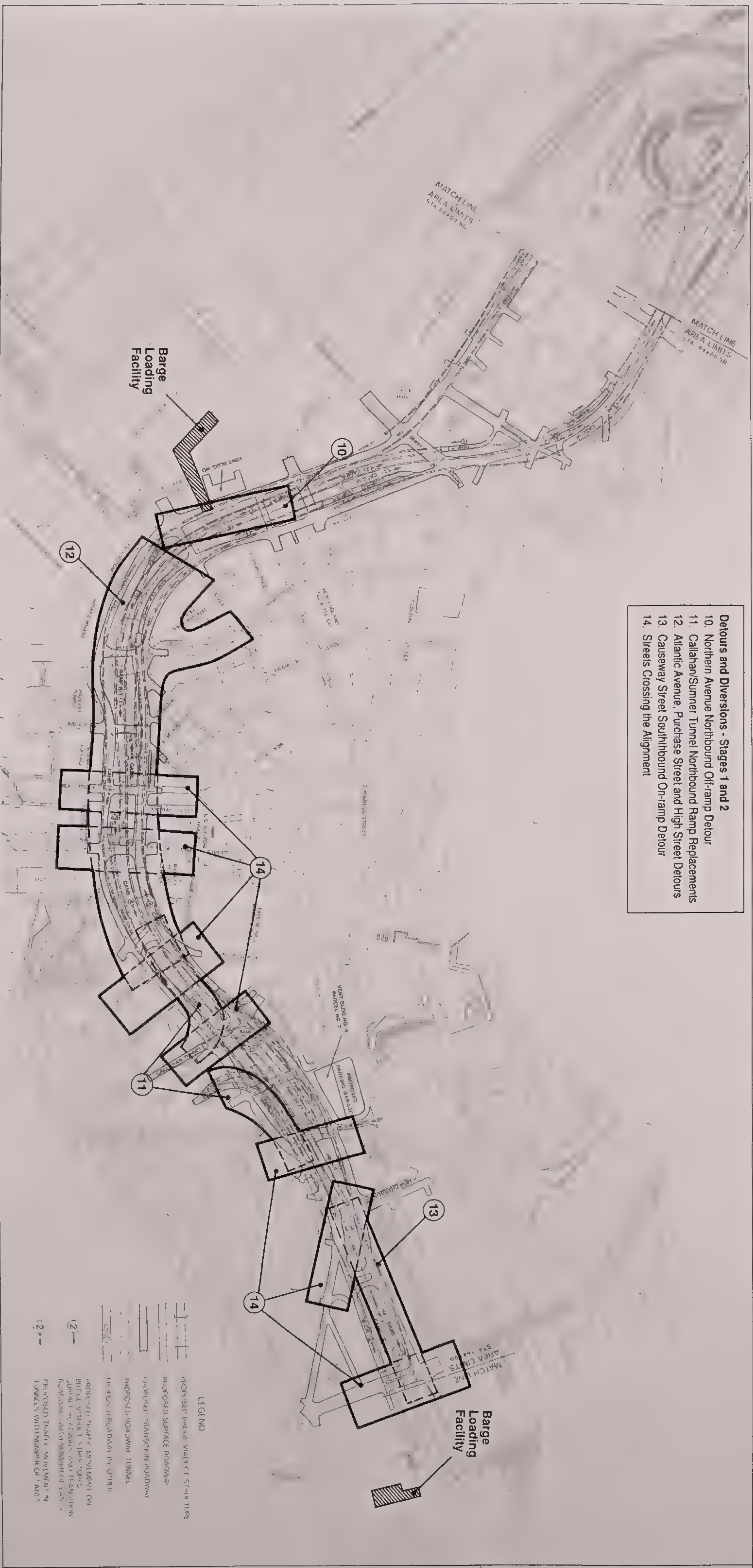
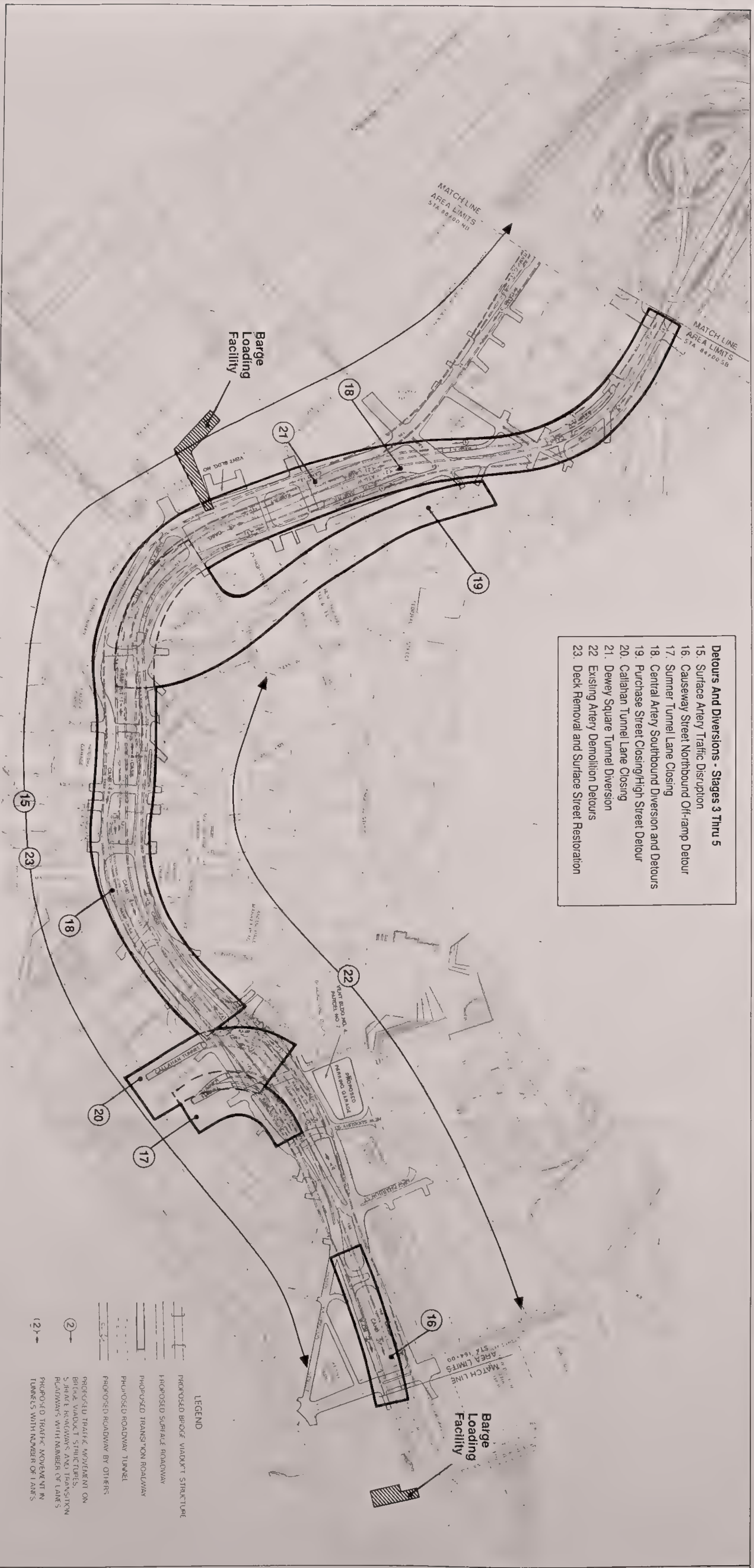

MATCH LINE
AREA LIMITS
Barge Loading Facility
10
12
11
13
14
PROPOSED PARKING GARAGE
VENT BLDG NO 4 PARCEL NO 7
Detours and Diversions - Stages 1 and 2
10. Northern Avenue Northbound Off-ramp Detour
11. Callahan/Sumner Tunnel Northbound Ramp Replacements
12. Atlantic Avenue, Purchase Street and High Street Detours
13. Causeway Street Southbound On-ramp Detour
14. Streets Crossing the Alignment
LEGEND
PROPOSED LINEAR VIADUCT STRUCTURE
PROPOSED SURFACE ROADWAY
PROPOSED TRANSITION ROADWAY
PROPOSED ROADWAY TUNNEL
EXISTING ROADWAY BY OTHERS
PROPOSED TRAFFIC MOVEMENT ON BRIDGE VIADUCT STRUCTURES, SURFACE ROADWAYS AND TRANSITION ROADWAYS WITH NUMBER OF LANES
PROPOSED TRAFFIC MOVEMENT IN TUNNELS WITH NUMBER OF LANES
0 100 200 400 800
FEET

FIGURE
20.16
Detours And Diversions - Stages 1 And 2
Central Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



Detours And Diversions - Stages 3 Thru 5

15. Surface Artery Traffic Disruption
16. Causeway Street Northbound Off-ramp Detour
17. Sumner Tunnel Lane Closing
18. Central Artery Southbound Diversion and Detours
19. Purchase Street Closing/High Street Detour
20. Callahan Tunnel Lane Closing
21. Dewey Square Tunnel Diversion
22 Existing Artery Demolition Detours
23. Deck Removal and Surface Street Restoration

FIGURE
20.17

Detours And Diversions - Stages 3 Thru 5
Central Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET

New Sudbury, North Washington, and Causeway Streets. Maximum volumes during this phase will generally not exceed 40 to 50 truckloads per day (five to six two-way trips per hour). Crossings will be controlled by flagmen and traffic signals. Peak truck volumes north of North Street will occur in late 1994 and throughout 1995, during the tunnel excavation work, when an average of 130 truckloads per day are anticipated.

During mainline construction, all excavated material removed from the area between North and Summer Streets will be trucked to the Fort Point Channel barge loading facility near the existing Boston Edison facility. These trucks will travel on a designated haul route utilizing existing streets. During the initial excavation phase, construction vehicles will be required to travel along or intersect with existing streets at grade. Crossings will be controlled by flagmen and traffic details. Access to barge loading facilities will be made via northbound Atlantic Avenue.

During the peak year of 1995, excavation volumes will increase to an average of about 180 truckloads per day. Trucks will travel beneath decked-over portions of the Surface Artery, where possible, to reach the barge loading facility directly, thereby minimizing the effect on surface street operations.

Excavation for the new tunnels between Dewey Square and (approximately) High Street will occur later, after the new northbound tunnel is completed. Excavated material from this area will be hauled to the Fort Point Channel barge loading facility in 1996 through 1998. The peak rate could reach 200 truckloads per day (24 two-way truck trips per hour). Trucks will be required to use Purchase Street, Congress Street, Atlantic Avenue, and Milk Street.

Some debris and construction products, such as slurry removed from slurry wall trenches, will require specialized handling and disposal measures. Excessively wet material, such as excavation from the slurry trenches, can be mixed with dry material prior to trucking, or the material can be hauled in sealed trucks that will contain leakage. Used slurry will be hauled in tank trucks to remote drying yards prior to disposal; however, such materials are expected to generate only periodic truck trips, with vehicle routings determined during final design. Some temporary drainage of water may occur, as described under Section 20.4.7, Water Resources And Ecology.

Approximately 1.3 million cubic yards of concrete will be required to construct the Central Area portion of the project. The Central Area is accessible to several major suppliers, and the construction of additional concrete supply facilities will not be required. The primary routes for concrete deliveries will be from the north, using either I-93 or North Washington Street via the Charlestown bridge, or from the west using the Massachusetts Turnpike.

Trucks approaching the project area will be required to use the Surface Artery and will park in designated construction zones to off-load. Temporarily parked concrete trucks may cause some temporary vehicular queuing and other on-street disruptions during certain phases of the operation. However, through traffic will be maintained at all times, and traffic rerouted or other mitigation measures will be taken, if a problem develops.

Concrete demand will begin in 1993 with the construction of the slurry wall panels for the utility relocation program. Demand will increase during the slurry wall construction, Artery underpinning, decking work, and tunnel construction that will take place between late

1993 and 1996. Peak concrete demand volumes will occur from 1994 to 1996 when the massive concrete placements in the new tunnels will be fully under construction. Concrete truck volumes for the entire Central Area will average 200 two-way trips per day between 1994 and 1996, decreasing to an average of 100 to 150 two-way trips between 1996 and 1997. Peak truckload volume could exceed the average by an additional 50 percent on any particular day.

Structural supports, forming materials, steel reinforcing rods, concrete-embedded items, and finishing materials (including tiling, lighting, etc.) also will be brought to each construction site by trucks using the Surface Artery. The truck delivery requirements associated with these materials will vary with each phase of the work, but can be expected to continue throughout the construction period. Peak truck volumes are estimated to reach 50 trips per day (five to six two-way trips per hour) during years 1995 to 1998. The impact of these deliveries will be mitigated somewhat by scheduling many of the deliveries for the second shift operation, thereby limiting the impacts to surface street operations.

Placement of backfill required to fill the void between the tunnel roof and the surface street will occur, primarily, during 1997 and 1998. Much of the backfill cannot be placed to the surface grade level until after the existing Artery and its temporary support structures are removed. Approximately 1.3 million cubic yards of material will be required.

Specifications for the project will place limitations on the gradation and plasticity requirements of the backfill material so that good compaction can be achieved. These limitations will probably prevent the reuse of almost all of the excavated material. Potential sources of backfill include: the I-95 fill in Saugus; clean sand from the Plymouth area; material from the sand and gravel pits to the north and west of Boston. Rock excavated from the tunnels constructed for the MWRA's Deer Island Project is another possibility; this could be barged into the Dry Dock #3 barge loading area.

Approximately 1.0 to 1.5 million cubic yards of rock will be removed from these tunnels; however, this rock will be too coarse and would require additional crushing and then stockpiling. Economics at the time of backfill placement will govern the selection of source(s) ultimately to be used. Backfill material could be delivered to the Boston area by truck, rail, or barge depending on the source. Material delivered by rail could be unloaded at the rail yard in Charlestown if brought in from the north, or in South Boston if brought in from the south or west. Material would then be transferred by trucks to the placement location. Material delivered by barge could be unloaded at the Dry Dock #3 barge loading facility and transferred to trucks. Peak truck volumes for backfill in the Central Area will occur in 1998 when approximately 200 truckloads per day (25 two-way trips per hour) will be delivered.

Construction Work Areas: Contractor work areas in the downtown Boston area will be limited. Throughout the construction period contractors will be provided with designated areas within their work limits for laydown and storage of equipment and materials, and will be required to confine their activities to those areas. Contractor and employee parking will not be available within or adjacent to the construction right-of-way in the Central Area. Workers will be required to park in facilities away from the work area, use public transportation, or park in the contractor remote parking area and be bused to and from the work site. Because construction shifts will generally begin at 6 to 7 AM and end at 3 to 4 PM, the five or six bus movements for each mainline contract should avoid peak rush hour travel periods and not add substantially to traffic volumes.

Generally, contractors will be required to control the extent of disruption caused by their work through coordinating work progress in the areas under construction at any point in time. Slurry wall construction, for example, will be conducted within defined and protected areas. As the operation progresses, the work area and protective boundary (generally jersey barriers and/or fencing) will move. Completed work will be covered with suitable surface materials to provide for safety and will be returned to vehicular and/or pedestrian use as soon as practicable.

I-93/I-90 Interchange And Massachusetts Avenue Interchange Area. The basic approach in this area will be to complete as much railroad and utility relocation work as possible in the early construction stages without detouring much vehicular traffic. As detours become necessary, through traffic will be maintained with the same number of lanes as currently exist to the extent possible. The use of local roads for major detours will be allowed only when there is no viable alternative.

The 15 detour and diversion conditions (shown in Figures 20.18 and 20.19) have been assessed based on the construction staging plans developed to date, and they are presented in the Supportive Engineering Report. It is anticipated that improvements in detour and diversion strategy and construction sequencing will be made during the detailed design phase, which will have positive effects on the maintenance of critical traffic conditions in this area.

Movement Of Construction Materials: Truck traffic related to the movement of construction materials (including excavated material, concrete, backfill, steel, and other components) will occur in three distinct patterns corresponding to the work conducted to the west of, to the east of, or within Fort Point Channel. All 2.3 million cubic yards of material excavated from the I-93 and I-90 corridor west of the Channel will be trucked via the existing interchange road network, including Kneeland Street, Albany Street, and Frontage Road, over the Channel to Dorchester Avenue. It is expected that the West Fourth Street bridge will be used for most truck traffic across Fort Point Channel with the Broadway bridge functioning as a secondary route. From Dorchester Avenue, the material will be moved via the South Boston Haul Road to the barge facility at the Dry Dock #3 site for transport to offshore disposal.

The 750,000 cubic yards of excavated material from the east side of Fort Point Channel will be trucked via A Street and Congress Street to the Massport Haul Road or barged in a manner described below. Dredged material from the Channel crossing will be either trucked via the same route, or transported through Fort Point Channel by low-profile barges capable of navigating within the confined vertical and horizontal clearances in the Channel. The maximum number of truckloads would be approximately 260 per day over a 3- to 4-year period. Trucking on second and third shifts will occur as necessary to maintain the construction schedule.

Over 90 percent of the approximately 980,000 cubic yards of concrete required for construction west of the Channel will be trucked to the site from the west via I-90 and from the north via I-93 and a combination of existing and temporary I-93 frontage roads. Concrete trucks will intermix with mainline traffic and will contribute to chronic traffic problems along both of these routes during peak periods. The routing of the concrete trucks will most likely follow Congress Street to A Street. During peak operations, the number of truck trips will be 12 to 15 per hour.

Most of the excavated material is expected to be unsuitable for backfill for this area. Accordingly, alternative sources of backfill are being investigated to supply the approximately 800,000 cubic yards needed. It is expected that backfill and other materials (such as structural steel, reinforcing steel, conduit, and cable) will be trucked to the site on a regular basis utilizing the South Boston Haul Road.

Construction Work Areas: Most of the identified contractor work areas are located west of Fort Point Channel and will be accessible via the existing I-93/I-90 roadway network.

The largest identified parcel is the area between West Fourth Street/Broadway bridge bordered by the Channel and the existing I-93 roadway. Area beneath the existing viaduct will be used for contractors' work areas within their respective limits of work. Early contracts will use the area between the I-93 northbound and the railroad tracks to South Station, as well as the open area southwest of the Wang building.

The space beneath the existing Massachusetts Avenue connector viaduct and the area vacated by the realignment of the connector will be utilized. The parcel (Boston Tire) between the Southampton Street bridge and the Dorchester Branch railroad bridge will be required for work access to extend these bridges and will also be used as a construction laydown area.

Contractor work areas are especially critical on the east shore of Fort Point Channel to support the tunnel construction and to provide access to the Channel for installation of the immersed tube sections. The only suitable parcel of land which meets this criterion is the Boston Wharf property adjacent to and north of the alignment abutting the Channel bank with access from Necco Street.

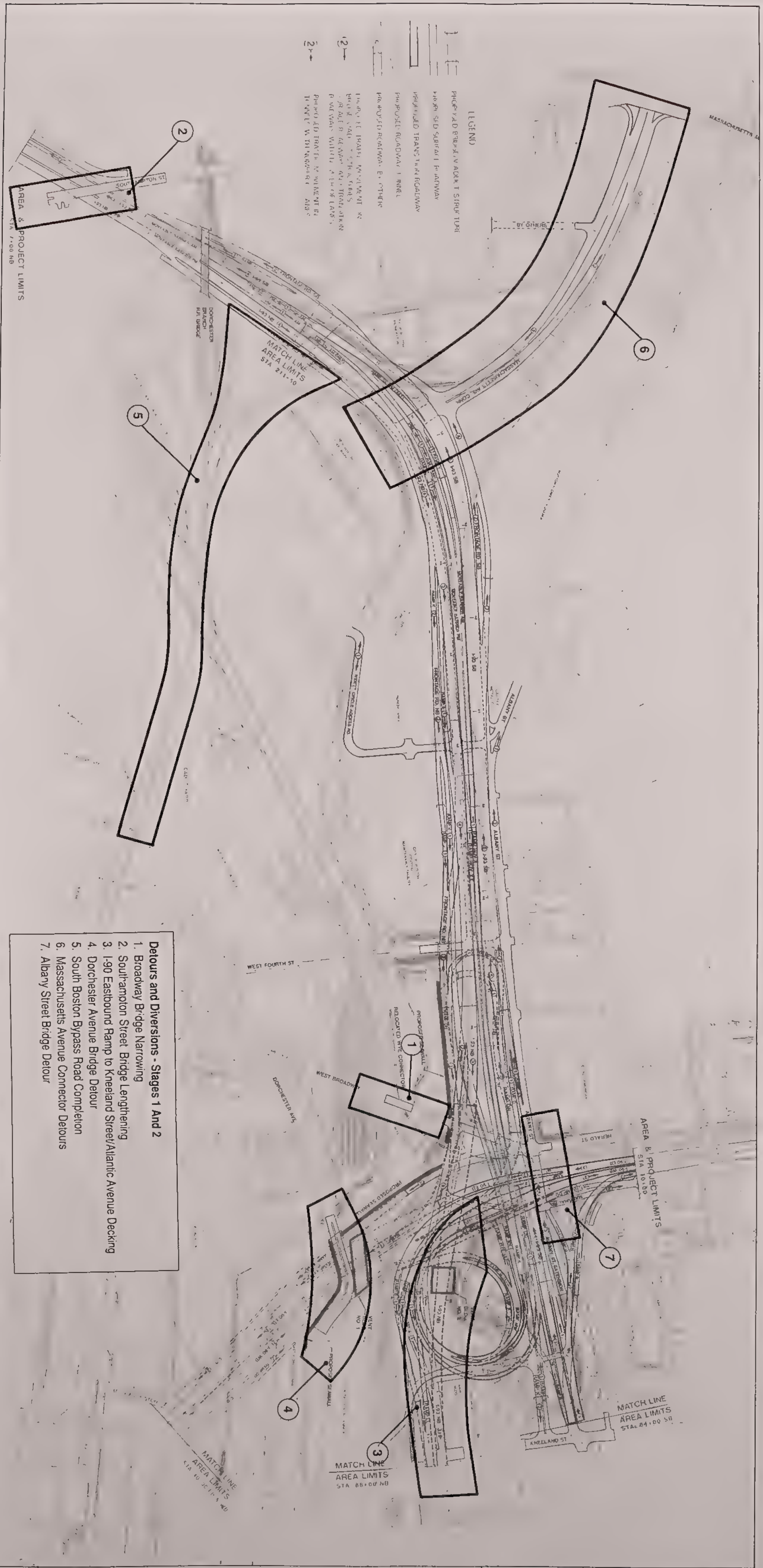
South Boston. The six detours and diversions that will affect traffic during construction in the South Boston area are described in the Maintenance of Traffic Plan appendix and shown in Figure 20.20. While some travel inconvenience is inevitable, all of these traffic conditions will occur along the same alignment as existing facilities, thus curtailing vehicular diversions to adjacent streets.

Movement Of Construction Materials: Movement of construction materials and equipment by truck and rail will take place throughout the 6-year construction period, and is expected to reach a peak volume of 820 truck trips per day over a 1.5-year period in the South Boston area. Most of these trips will be made within the project right-of-way via the new South Boston Haul Road, or to and from the proposed barge loading facility via the relocated Massport Haul Road, thus substantially reducing project-related truck travel on local area streets.

Approximately 2.9 million cubic yards of excavated materials will be trucked to barges at the BMIP via Dry Dock #3. Trucks will use the I-90 right-of-way or designated truck routes such as the South Boston Haul Road or the Massport Haul Road, whenever possible. At peak excavation periods, the barge loading facility will handle up to 640 truckloads per day.

Approximately 860,000 cubic yards of concrete will be required in this area.

Approximately 1 million cubic yards of backfill will be required. Material excavated from the South Boston areas could be used if it meets specifications and can be stockpiled on or



Detours and Diversions - Stages 1 And 2

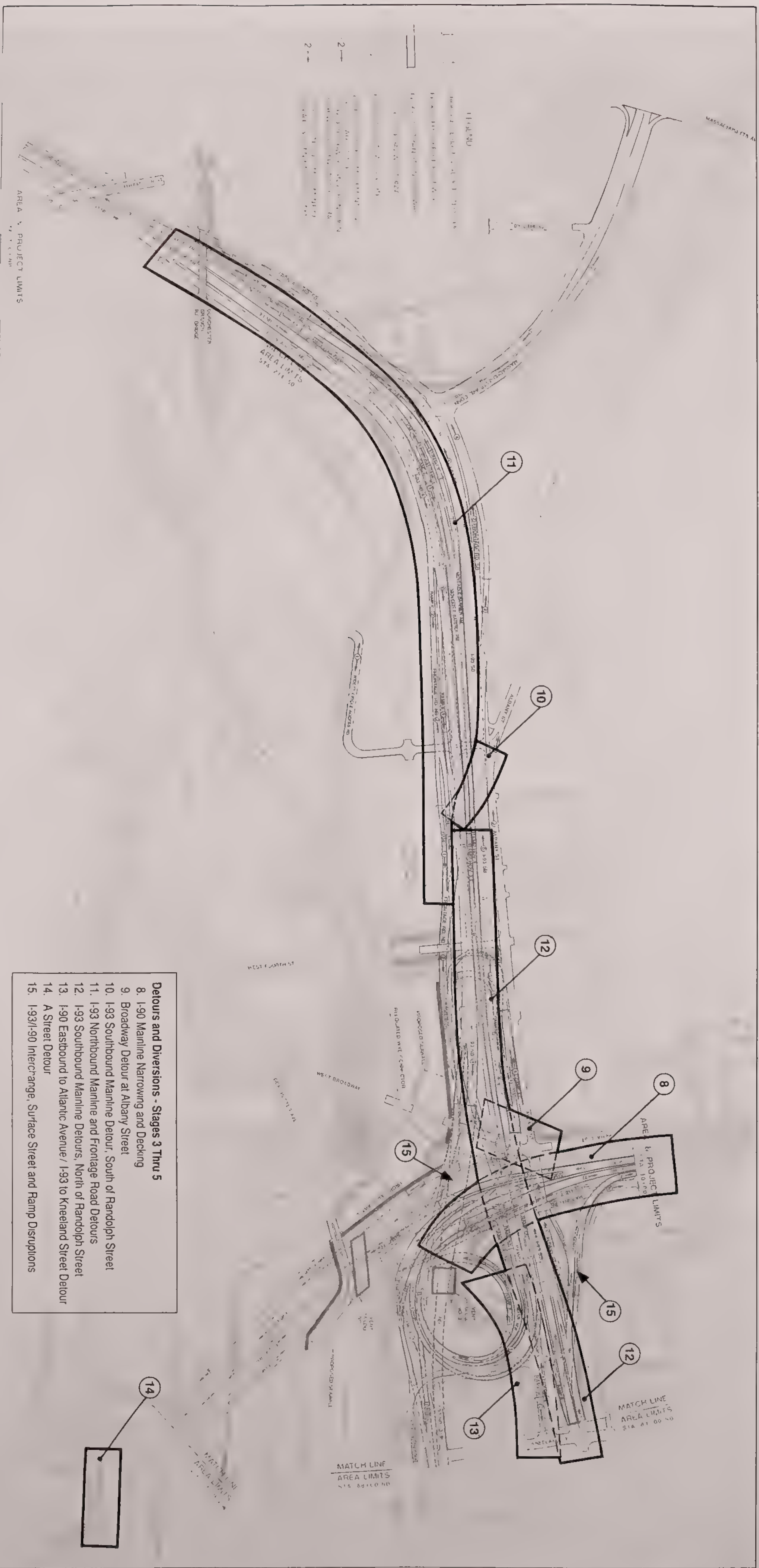
1. Broadway Bridge Narrowing
2. Southampton Street Bridge Lengthening
3. I-90 Eastbound Ramp to Kneeland Street/Atlantic Avenue Decking
4. Dorchester Avenue Bridge Detour
5. South Boston Bypass Road Completon
6. Massachusetts Avenue Connector Detours
7. Albany Street Bridge Detour

FIGURE
20.18

Detours And Diversions - Stages 1 And 2
I/93-I/90 Interchange And Massachusetts Avenue
Interchange Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 100 200 400 800
FEET



Detours and Diversions - Stages 3 Thru 5

8. I-90 Mainline Narrowing and Decking
9. Broadway Detour at Albany Street
10. I-93 Southbound Mainline Detour, South of Randolph Street
11. I-93 Northbound Mainline and Frontage Road Detours
12. I-93 Southbound Mainline Detours, North of Randolph Street
13. I-90 Eastbound to Atlantic Avenue / I-93 to Kneeland Street Detour
14. A Street Detour
15. I-93/I-90 Interchange, Surface Street and Ramp Disruptions

FIGURE
20.19

Detours And Diversions - Stages 3 Thru 5
I/93-I/90 Interchange And Massachusetts Avenue Interchange Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 200 400 800
FEET

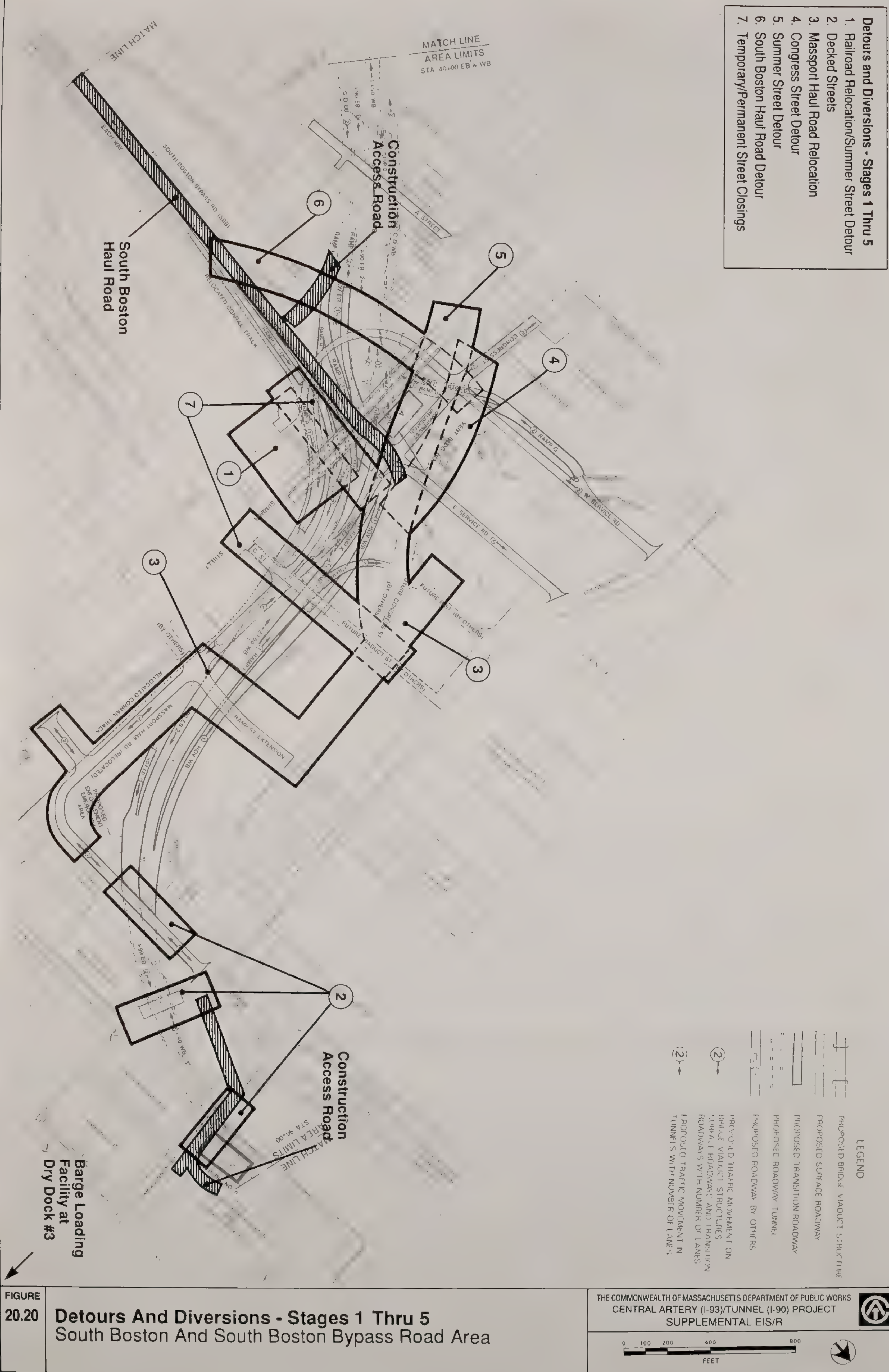

Detours and Diversions - Stages 1 Thru 5
1. Railroad Relocation/Summer Street Detour
2. Decked Streets
3. Massport Haul Road Relocation
4. Congress Street Detour
5. Summer Street Detour
6. South Boston Haul Road Detour
7. Temporary/Permanent Street Closings
MATCH LINE
AREA LIMITS
STA 40+00 EB & WB
Construction Access Road
South Boston Haul Road
SOUTH BOSTON BYPASS RD (SBBR)
EACH WAY
RELOCATED CONRAIL TRACK
A STREET
CONGRESS ST
RAMP C
W SERVICE RD
E SERVICE RD
VENT BLDG
SUMMER STREET
FUTURE VIADUCT ST (BY OTHERS)
FUTURE CONGRESS ST (BY OTHERS)
FUTURE EST (BY OTHERS)
MASSPORT HAUL RD (RELOCATED)
RAMP ST EXTENSION
HOV WB
I-90 EB
I-90 WB
PROPOSED EMERGENCY AREA
Construction Access Road
AREA LIMITS
MATCH LINE
STA 90+00
Barge Loading Facility at Dry Dock #3
LEGEND
PROPOSED BRIDGE VIADUCT STRUCTURE
PROPOSED SURFACE ROADWAY
PROPOSED TRANSITION ROADWAY
PROPOSED ROADWAY TUNNEL
PROPOSED ROADWAY BY OTHERS
PROPOSED TRAFFIC MOVEMENT ON BRIDGE VIADUCT STRUCTURES SURFACE ROADWAYS AND TRANSITION ROADWAYS WITH NUMBER OF LANES
PROPOSED TRAFFIC MOVEMENT IN TUNNELS WITH NUMBER OF LANES
0 100 200 400 800
FEET

FIGURE
20.20

Detours And Diversions - Stages 1 Thru 5
South Boston And South Boston Bypass Road Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

near the alignment. Due to the quantity and timing of backfill needs, most fill will be brought in by truck using the South Boston Haul Road or by railroad, or barged from sites identified in Section 20.1.1.

The vast majority of materials used to construct the Third Harbor Tunnel, including tube sections, would be moved by water transportation. All construction activities will be closely coordinated with the Harbormaster (Boston Police), the Coast Guard, and other appropriate agencies. Excavated materials from the tube trench across the Harbor will be barged to the Massachusetts Bay Disposal Site, or, in the case of rock and fill material, to Spectacle Island. Sand bedding, backfill, and the scour protection backfill/riprap will be barged in from sites determined by the contractor. The small amounts of ballast concrete and concrete for the final closure will probably be produced by a small floating batch plant. Concrete for internal joints, as well as materials for interior finish work such as tile, lights, and signs, will be brought in through the access tubes at East and South Boston.

Construction Work Areas: The South Boston area contains adequate vacant land for contractor work areas during the construction period, including parcels within the project right-of-way and other large vacant private and publicly owned sites. Much of the required area can be obtained by using remnants of parcels acquired for the project and the I-90 right-of-way, when not under construction. Some of the larger sites available will be the northeast corner of Subaru Terminal, the Commercial Union site, the Pappas building site, excess Conrail property west of the South Boston Haul Road, the Lewis and Sullivan parking lots north of Wormwood Street, and the Boston Wharf property west of A Street and north of Mt. Washington Street. Portions of a 27-acre parcel of land between Congress Street and Northern Avenue will also be utilized for various I-90 construction-related activities, including a temporary concrete batch plant.

For Third Harbor Tunnel construction, tube fabrication and outfitting, and docking space for the various pieces of marine equipment (including work boats, lay barges, and tugboats, and possibly for tube sections ready to be placed) could be remote from the tunnel sites. Economic considerations require that they should be as close to the construction site as possible. Docking space is also required for access by the contractors' personnel. Access at each end of the tunnel would be required to begin the tube installation and later for entry via access shafts to the tunnel interior. The dike area east of the Third Harbor Tunnel on Bird Island Flats will be used for the various contractor activities.

South Boston Bypass Road Area. Except for the detour through the U.S. Postal Service parking facility (described in the South Boston Area), no major detours of South Boston auto traffic will be required. The project will not affect railroad freight service in the Conrail cut and railroad yard area in South Boston. The Widett Circle access driveway from the South East Expressway to the New Boston Food Market area will require relocation. This driveway will be placed on a new alignment on the opposite side of the same property.

The South Boston Bypass Road is on a viaduct structure over existing railroad and rapid transit tracks. Close coordination with MBTA, Amtrak, and Conrail will be required during construction over these active tracks.

Cars and buses entering and leaving the Cabot Yard will be required to use alternate entrances while the new main entrance is being built.

Construction Work Areas: Temporary staging areas may be available to accommodate construction equipment inside the existing Haul Road "loop" at Cabot Yard; adjacent to and west of the Haul Road near the U.S. Postal Service facility; and near the proposed viaduct adjacent to Widett Circle. The construction of the connections from I-90 to and from the South Boston Bypass Road will be done by the South Boston area contractor who will use the South Boston staging area described above.

Movement Of Construction Materials: Construction materials for construction of the South Boston Bypass Road would move via the South Boston Haul Road (of which the Bypass Road is an extension) and directly into the Widett Circle area from the Southeast Expressway Frontage Road system.

East Boston/Logan Airport Area. At least 11 temporary detour traffic conditions and diversions will affect traffic in the Logan Airport/East Boston area. (Each condition is shown in Figure 20.21.)

Movement Of Construction Materials: Approximately 2.2 million cubic yards of excavated material will be trucked across Massport property using temporary access roads and existing service roads to the barge loading terminal at Bird Island Flats. At the peak of excavation activity, the terminal will handle approximately 440 truckloads per day over a 15-month period. If suitable space is available, material acceptable for backfill will be stockpiled for later use. If reusable excavation material is unavailable, backfill will be brought in by trucks or via barges.

To avoid excessive concrete truck traffic in surrounding neighborhoods and on Route 1A during peak hours, a temporary concrete batch plant serving the East Boston construction contracts will be established between Harborside Drive and the airport access road area. Aggregate and sand will be trucked in via Route 1A during off-peak traffic hours. Construction equipment and miscellaneous materials will be trucked to the construction sites via Route 1A.

A temporary route for construction vehicles is proposed west of East Boston Memorial Stadium Park. This route will be used to move construction materials such as concrete and excavated material back and forth between Bird Island Flats and the Route 1A area without interrupting airport access and egress traffic. It will begin at the North Area Service Road near the MBTA substation and run between the park and the Blue Line station. It will turn southwesterly and join Harborside Drive near Emery Air Freight. This will allow all construction movement to occur along the access and egress roads.

In addition, construction equipment and material movements related to demolition, relocation, and reconstruction of airport facilities within the project right-of-way will occur. Integration of project-related construction traffic with airport and other traffic will be addressed in the Maintenance of Traffic Plan as the project progresses.

Construction Work Areas: Most of the Logan Airport and East Boston project area is currently being utilized, and construction space will be at a premium. Remnants of parcels taken for construction and I-90 right-of-way not actually under construction will be utilized for field offices, construction equipment, materials storage, and on-site fabrication. Many of the facilities to be demolished for I-90 construction will be relocated by Massport to other areas of the airport; therefore, use of existing, apparently

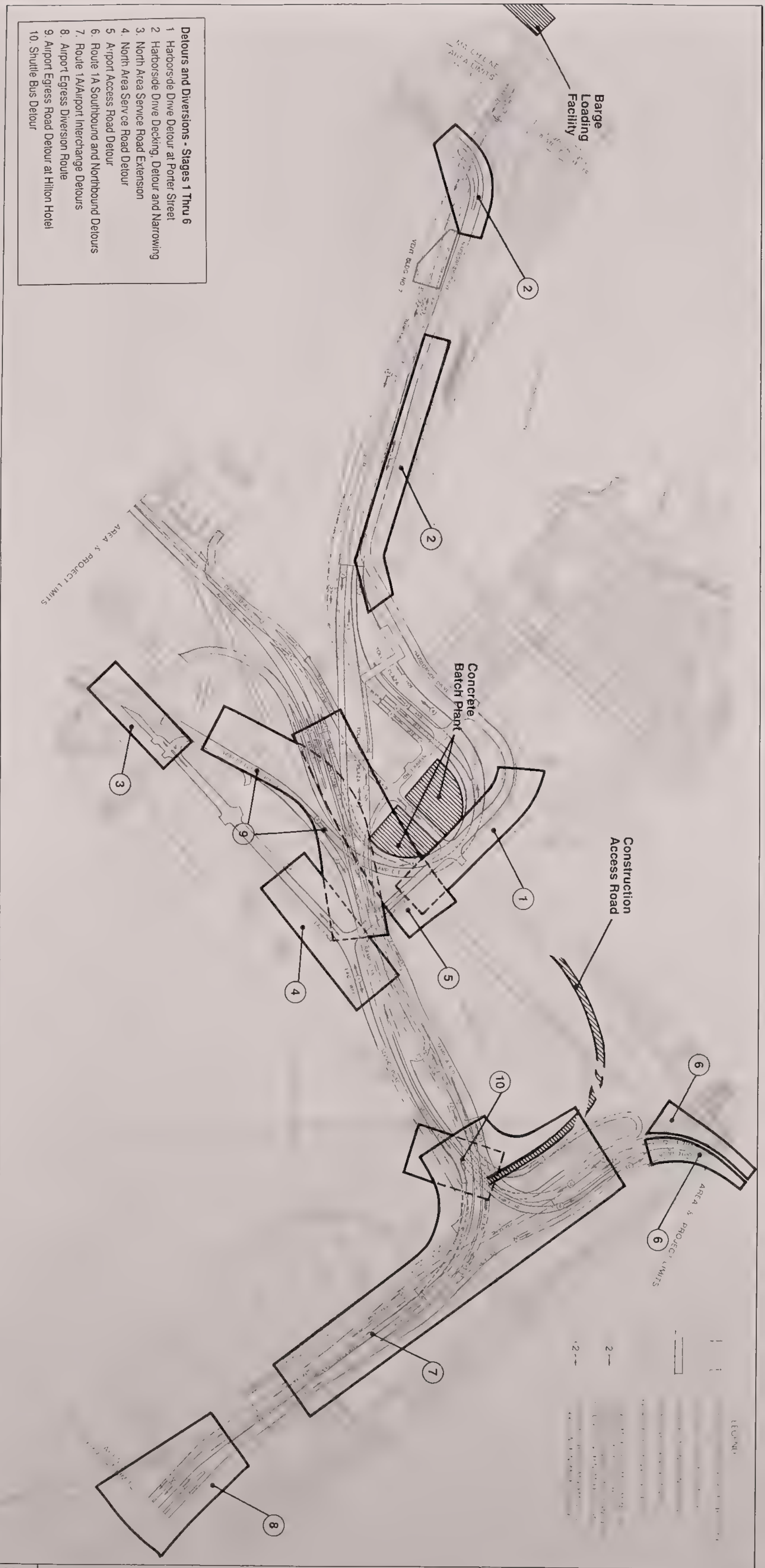

Detours and Diversions - Stages 1 Thru 6
1 Harborside Drive Detour at Porter Street
2 Harborside Drive Decking, Detour and Narrowing
3. North Area Service Road Extension
4. North Area Service Road Detour
5 Airport Access Road Detour
6. Route 1A Southbound and Northbound Detours
7. Route 1A/Airport Interchange Detours
8. Airport Egress Diversion Route
9. Airport Egress Road Detour at Hilton Hotel
10. Shuttle Bus Detour
Barge Loading Facility
Concrete Batch Plant
Construction Access Road
AREA 5 PROJECT LIMITS
AREA 5 PROJECT LIMITS
1
2
2
3
4
5
6
6
7
8
9
10
LEGEND

FIGURE
20.21

Detours And Diversions - Stages 1 Thru 6
East Boston/Logan Airport Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

FEET

open areas must be closely coordinated. The barge loading facilities are planned for the Bird Island Flats area at the end of Harborside Drive. Any large open area available could be used to store excavated material until it can be recycled for backfill.

Construction personnel will be expected to use public transportation, such as the MBTA Blue Line or contractor-furnished transportation from remote laydown areas.

Summary Of Detours And Diversions. Sixty detours and diversions have been identified and described which could affect traffic in local areas during various stages of construction. Based on the work conducted to date, an estimated 34 traffic conditions may require some form of mitigation. (Figure 20.22 lists these potential traffic mitigation conditions by subarea and the stage of construction during which they are expected to occur.)

As discussed in the Maintenance of Traffic Plan Appendix, a wide range of mitigation measures are potentially applicable to ease these traffic conditions. These measures are being investigated, and the most appropriate mitigation program will be analyzed and determined when more detailed site-specific traffic and construction information is available during final design.

20.2.1(c) Pedestrian Circulation

Free and unrestricted pedestrian circulation is a critical condition for some areas of the project, such as downtown Boston, the North End, and the waterfront, but is less important in other areas, such as Bird Island Flats. Pedestrian safety is a major projectwide priority. Transit stations, transportation terminals, office buildings, hotels, and public institutions all require unrestricted public access. This section describes temporary impacts on pedestrian circulation resulting from the construction sequence proposed in each area of the project, as well as the effect on important facilities, and bicycling.

Area North Of Causeway Street. Little pedestrian movement occurs within the project right-of-way on the north side of the Charles River. South of the Charles River, the primary pedestrian activity affected involves access to the North Station platforms (see Figure 20.23). New viaduct structures connecting the Central Artery to the Storrow Drive/Leverett Circle area will pass over the station paralleling the existing viaduct. Access to trains will be maintained, and protective walkway enclosures will be provided where required during the construction of the new viaducts and removal of the existing viaduct.

A north/south pedestrian route currently extends through the area from Causeway Street to Charlestown via the new Charles River dam walkway and Paul Revere Landing Park. Access at the north end will not be affected by the project. On the south side of the river, access is achieved by walking through a parking lot under the existing I-93 bridge. Although construction of the new bridge will occur to the west of the existing bridge, access to the south end of the Charles River dam will be achieved by the operation of a barge loading facility near the dam and by demolition of the existing Charles River high bridge.

Access to the south end of the dam will be maintained during the entire construction period. However, due to truck traffic which must cross the route and construction/demolition activity occurring in the vicinity, the quality of this route will be diminished. The Charlestown bridge, with walkways on both sides, provides an alternate route for pedestrians using the Charles River dam. The bridge, a part of the Freedom Trail, already carries a greater volume of pedestrian traffic than does the dam walkway. In most cases, using the Charlestown bridge will not add to walking distances, since the two crossings begin and end at nearly identical points.

New ramps will be constructed to Leverett Circle as a part of the Artery/Tunnel Project. This construction will include a new tunnel under the Circle adjacent to the existing tunnel and extensive reconfiguration of roadways in the area. In a separate project, the MBTA will be reconstructing the Green Line south of Science Park station to pass under the proposed new Boston Garden. Construction on the Green Line will require that this segment of the line be closed for some time during the implementation of that project.

Construction in the area will affect walkways around the Circle and a pair of pedestrian bridges which lead to the station and provide an overpass across the Circle. It may be necessary to remove one or both pedestrian bridges for some period during construction.

When details of the construction schedule for ramps around Leverett Circle have been determined, and the exact schedule for construction on the Green Line is known, plans will be developed to maintain pedestrian movement around the Circle at all times. Access to the station will not be interrupted when the station is operational. Construction of Central Artery ramps around the Circle will be coordinated with work on the Green Line where possible to minimize impacts to pedestrian movement and transit service.

Central Area. A large number of pedestrians cross the Central Artery each day. The alignment separates the core of the Central Business District to the west from North End residences and restaurants, the waterfront, two hotels, and three transportation facilities (Aquarium station on the Blue Line, Rowes Wharf ferry terminal, and South Station). Although there are approximately 18 points at which pedestrians can cross within the Central Area, the bulk of activity occurs at five major crossing points: Dewey Square, the Oliver Street pedestrian bridge, Rowes Wharf walkway, the Walk to the Sea, and the Haymarket-North End walkway (shown in Figure 20.23).

Pedestrian detours at these and other locations will be consistent with the activities occurring during each construction stage and plans for maintenance of cross-vehicular traffic at specific locations (as described in the Maintenance of Traffic Plan Appendix). These will be programmed into the Maintenance of Traffic Plan based on final project design and community input. More temporary traffic and pedestrian access and safety measures, including access to adjacent structures, will be addressed as a part of individual construction contractor responsibilities in accordance with preapproved contractor work plans and the City of Boston's Construction Management Plan.

I-93/I-90 Interchange And Massachusetts Avenue Interchange Area. Because of the industrial and railroad uses in this area, pedestrian movements are not a major issue. Existing crosswalks and sidewalks within the construction area will be maintained as a part of contractors' responsibilities throughout the construction period.

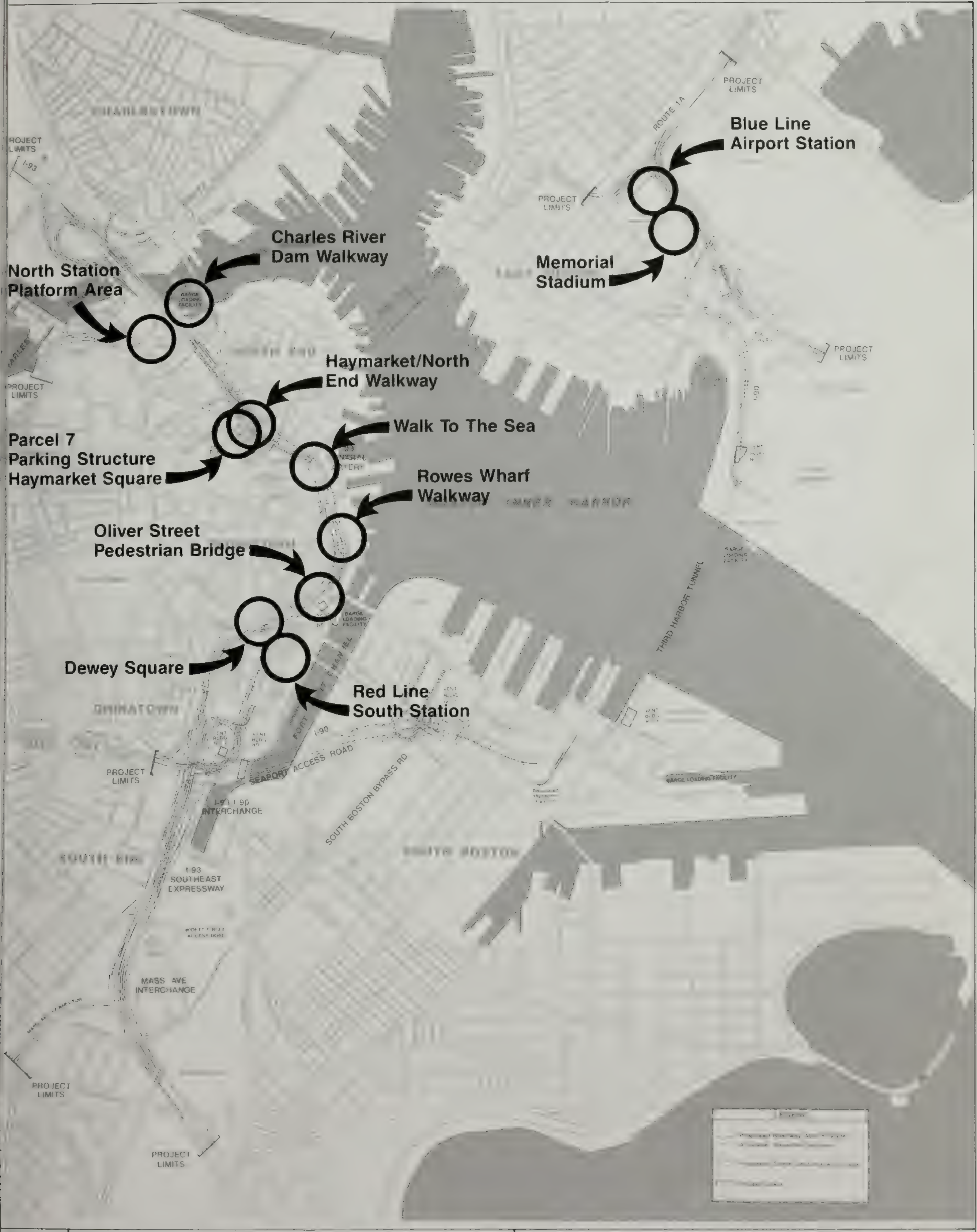
South Boston And South Boston Bypass Road Area. Pedestrian access will be maintained throughout the construction area, including the temporary Summer Street detour structure, as

SUBAREA AND TRAFFIC CONDITION	STAGE OF CONSTRUCTION					
Area North of Causeway Street	1	2	3	4	5	6
2. Leverett Circle Connection Detour			●			
3. Storrow Drive Detours and Narrowing			●			
4. I-93 Bent Modification Detours		●	●			
5. Leverett Circle Connection Bent Modification Detours			●			
Central Area						
1. Utility Relocation Detours and Diversions	●					
2. Northern Avenue Northbound On-Ramp Detour	●	●	●			
3. High Street Directional Flow Reversal and Detour	●					
4. Kneeland to Summer St. Slurry Wall, Street Closings and Detours	●					
5. Summer Street to Northern Avenue Slurry Wall	●					
6. Summer and Congress Streets and Northern Avenue Narrowing	●					
7. Northern Avenue to Callahan Tunnel Slurry Wall	●					
10. Northern Avenue Northbound Off-Ramp Detour	●	●	●			
12. Atlantic Avenue, Purchase and High Streets Detours		●				
13. Causeway Street Southbound On-Ramp Detour		●	●	●	●	
14. Streets Crossing the Alignment		●				
15. Surface Artery Traffic Disruption			●	●	●	
16. Causeway Street Northbound Off-Ramp Detour			●	●	●	
17. Sumner Tunnel Lane Closing			●			
18. Central Artery Southbound Diversions and Detours				●		
19. Purchase Street Closing/High Street Detour				●		
20. Callahan Tunnel Lane Closing				●		
I-93/I-90 and Masschusetts Avenue Interchange Area						
1. Broadway Bridge Narrowing	●					
6. Massachusetts Avenue Connector Detours		●				
8. I-90 Mainline Narrowing and Decking			●	●	●	
9. Broadway Detour at Albany Street			●			
12. I-93 Southbound Mainline Detours, North of Randolph Street					●	
13. I-90 Eastbound to Atlantic Avenue/I-93 to Kneeland Street Detour			●	●		
South Boston and South Boston Bypass Road Area						
1. Railroad Relocation/Summer Street Detour	●					
4. Congress Street Detour			●	●	●	
5. Summer Street Detour					●	
East Boston/Logan Airport Area						
5. Airport Access Road Detour				●	●	●
6. Route 1A Southbound and Northbound Detours				●	●	
8. Airport Egress Diversion Route				●	●	
9. Airport Egress Road Detour at Hilton Hotel					●	

FIGURE

20.22 **Traffic Conditions Identified For Potential Mitigation**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



FIGURE

20.23

Potential Pedestrian Impact Locations

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

Avenue, West Second Street, and Summer Street in South Boston, and Porter Street in East Boston. Bicycle traffic on these routes is light during the summer and almost nonexistent in the winter.

As bicycles are operating in streets with other traffic, passage will continue at all of these locations throughout construction, and routes which cross project areas on bridges in South Boston will not be affected at all. Although bicyclists will continue to be able to use routes in the Central Area, detours, increased congestion at points, and general construction conditions are not favorable to cyclists, so some will divert to other routes or areas.

20.2.1(d) Public Transportation

Public transportation facilities and services will be greatly expanded during project construction as a part of the ongoing and proposed Maintenance of Traffic Plan. To the extent that these improvements slow or reduce the growth in automobile travel, as well as mitigate temporary construction-related traffic conditions, both short- and long-term benefits will accrue toward better mobility and air quality. Potential negative effects on existing bus service and planned transit facilities in the project study area are described below, followed by more detailed discussion of effects on subway and commuter railroad facilities within each subarea. (Affected subway and commuter railroad facilities are shown in Figure 20.24.)

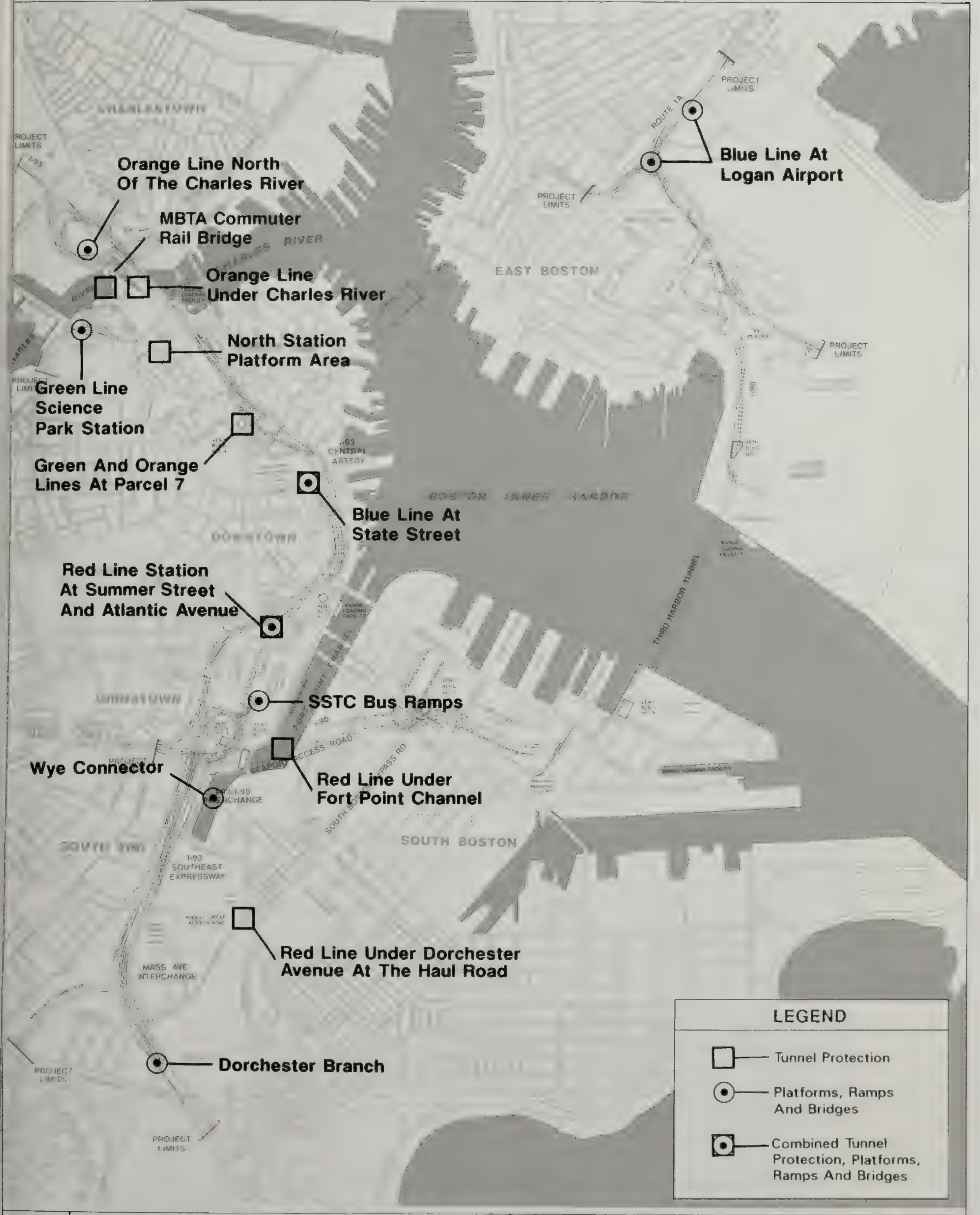
Buses. Some temporary disruption to buses operating in mixed traffic during peak hours will occur, similar to conditions which exist today on downtown-oriented commuter routes. Also, some temporary alterations in public and private bus routes may be needed, along with the locations and durations of layover parking. For example, provisions have already been made in the construction plans to accommodate South Station bus services during construction along Atlantic Avenue (see SSTC Bus Ramp Detour below). These disruptions are not expected to be substantial and will be addressed on an individual basis with the public and private operators during final design.

South Boston Transit Alternatives. The MBTA is currently conducting a State-funded analysis of transit alternatives within the project area, from the Boston Marine Industrial Park to North Station. This study has been coordinated with the Artery/Tunnel Project and has the same 2010 design year. In its Draft Environmental and Impact Report dated November 1989, the MBTA recommends the underground transit way as the preferred alternative and estimates its operating date as 1998.

Thus far, no decision has been made regarding approval or funding of the preferred transit alternative. More specific details regarding the accommodation of this facility will be developed during final design.

Other Transit Projects. The MBTA has programmed improvements at several locations which represent opportunities for advancing construction of the Artery/Tunnel Project in a potentially more efficient manner. These opportunities primarily involve slurry wall construction in connection with the following transit improvements.

- o Aquarium Station - slurry wall near highway crossing above the Blue Line.
- o SSTC - slurry wall along Atlantic Avenue.
- o North Station - slurry wall.


Orange Line North Of The Charles River
MBTA Commuter Rail Bridge
Orange Line Under Charles River
North Station Platform Area
Green Line Science Park Station
Green And Orange Lines At Parcel 7
Blue Line At State Street
Red Line Station At Summer Street And Atlantic Avenue
SSTC Bus Ramps
Wye Connector
Red Line Under Fort Point Channel
Red Line Under Dorchester Avenue At The Haul Road
Dorchester Branch
Blue Line At Logan Airport
CHARLESTOWN
CHARLES RIVER
EAST BOSTON
BOSTON INNER HARBOR
DOWNTOWN
CHINATOWN
SOUTH END
SOUTH BOSTON
I-93 CENTRAL ARTERY
I-93 SOUTHEAST EXPRESSWAY
MASS AVE INTERCHANGE
I-90 INTERCHANGE
THIRD HARBOR TUNNEL
FORT POINT CHANNEL
SEAPORT ACCESS ROAD
SOUTH BOSTON BYPASS RD
ROUTE 1A
I-90
PROJECT LIMITS
LEGEND
Tunnel Protection
Platforms, Ramps And Bridges
Combined Tunnel Protection, Platforms, Ramps And Bridges

FIGURE

20.24

Affected Subway And Commuter Railroad Facilities

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

a part of all contractor agreements. A need for special pedestrian measures has not been identified at this time in the South Boston industrial area because of low pedestrian activity in the vicinity of project construction.

Third Harbor Tunnel Area. This area of the project is entirely underground and mostly under Boston Harbor. No pedestrian routes are present in this area.

East Boston/Logan Airport Area. Pedestrian movement in this area is limited and largely confined to the area around Airport station on the Blue Line and East Boston Memorial Stadium. The remainder of the area is characterized by airport support services where most movement is by automobile or shuttle bus.

Two pedestrian routes connect both the Blue Line station and Memorial Stadium to nearby neighborhoods and have a light but steady flow of pedestrians. The first is a route along Orleans Street to Porter Street. From here, all neighborhoods in the area can be reached. This route will be affected by construction on the Airport station, reconstructing the bus loop, and demolition of two ramps passing over Orleans Street. It will remain open to pedestrian movement at all times.

The second pedestrian route is an illegal short-cut to Bremen Street northwest of the station. This dirt path crosses the Blue Line at its tunnel portal, passes under Route 1A bridges, crosses the Boston and Albany Railroad (inoperative), and passes through the back of Scolly Trucking Company property to the intersection of Bremen and Marion Streets. Though both the Scolly Trucking property and the State-owned land under Route 1A are posted with no trespassing signs, this route is used by a small number of pedestrians. This route will be extensively affected by demolition and construction of Route 1A ramps and the station bus loop, and it will be impassable at times during construction. Pedestrians who use this route will be diverted along the route previously discussed -- to Porter Street, then north to Bremen Street. This increases the walking distance from 1,400 feet to 2,000 feet to the intersection of Bremen and Marion Streets.

The second pedestrian route is an illegal short-cut to Bremen Street northwest of the station. This dirt path crosses the Blue Line at its tunnel portal, passes under Route 1A bridges, crosses the Boston and Albany Railroad (inoperative), and passes through the back of Scolly Trucking Company property to the intersection of Bremen and Marion Streets. Though both the Scolly Trucking property and the State-owned land under Route 1A are posted with no trespassing signs, this route is used by a small number of pedestrians. This route will be extensively affected by demolition and construction of Route 1A ramps and the station bus loop, and it will be impassable at times during construction. Pedestrians who use this route will be diverted along the route previously discussed -- to Porter Street, then north to Bremen Street. This increases the walking distance from 1,400 feet to 2,000 feet to the intersection of Bremen and Marion Streets.

Bicycling. No marked bicycle routes or independent bikeways cross project alignments. However, the Boston Bikemap, prepared by the Boston Metropolitan Planning Organization, identifies a number of suggested bike routes which cross project areas. Recommended routes include crossings of the Central Artery at Causeway, Commercial, State, Milk, and High Streets. Atlantic Avenue is identified as the main route along the waterfront. Other routes which cross project areas include East Berkeley Street, Dorchester

The Project is conducting negotiations with the MBTA regarding these improvements. The result could be that the MBTA might construct portions of the Artery/Tunnel Project slurry wall as part of an MBTA improvement project.

Area North Of Causeway Street: Construction in this area will entail working in and around active railroad lines at several locations, including: the North Station platform area, where the new two-tier viaduct structure joins the existing viaduct; the Green Line at Science Park station and along Martha Way, where the new underpass below Leverett Circle will require a reconfiguration of the station supports; in Charlestown, just north of the abutment of the railroad bridge crossing the Charles River; and again further north near the Boston Sand & Gravel maintenance facility. Work at these locations will be coordinated with MBTA operations officials, based on more detailed development of the project's Maintenance of Traffic Plan, and will be conducted in a manner that minimizes disruption to rail service.

The new I-93 mainline roadway crosses the Orange Line tunnel at the north and south abutment areas and again at the tunnel portal area, north of the Charles River in Charlestown. Service on the Orange Line will be maintained throughout construction at these locations. Special measures will be taken to protect these tunnels during construction.

Central Area: The proposed Parcel 7 parking garage and ventilation building 4 will be located directly above and adjacent to the MBTA Green and Orange Line subway tunnels. The foundations for the parking garage must pass between and on either side of the Green Line. The horizontal space between the subways varies from 0 to approximately 9 feet. To minimize displacements and vibrations due to foundation construction, pre-excavated cast-in-place piers will be required.

Work at this location will also entail modifications to the mezzanine and platform levels of the Haymarket station, as well as a reconfiguration of the station entrance. During this work, the entrance will be closed for approximately 4 months and passengers will be required to enter and leave the station from the Government Center Garage entrance.

Also, special tunnel protection measures and construction methods will be needed where the roadway tunnel passes below the existing Red Line station at Summer Street/Atlantic Avenue, and over the Blue Line at State Street. Underpinning the Red Line station will involve jacking and supporting techniques which preclude movements and settlement within the station and trackage above. Red Line and station operations will continue throughout the construction period, and the entire procedure will be monitored for settlement and vibration.

Construction over the Blue Line will be performed using a bridging method so that the weight of the roadway does not bear on the transit tunnel. Occasional temporary shutdowns of transit service may be required. These shutdowns will be planned during the off-peak or late evening hours, and operations will be largely unaffected by the work. As was the case with the Red Line tunnel protection program, a settlement monitoring program will be conducted throughout the work.

South Boston And South Boston Bypass Road Area: No public transportation facilities or service will be affected in this area.

East Boston/Logan Airport Area: Agreements will be reached with MBTA regarding relocation of the Blue Line tracks, and modifications to Airport station to improve the bus/train interface. While construction can be accomplished primarily during late night periods, some temporary disruption of subway service in this area may occur.

20.2.1(e) Navigation

During the construction phase, the Artery/Tunnel Project will have two types of temporary effects on marine traffic in Greater Boston: those caused by construction activity in navigable waters; and those caused by project-related barge traffic. These effects are not expected to be serious. However, a recent study (The Boston Inner Harbor Water Transportation Study, October 1989) documents a growing concern regarding harbor congestion, and recommends new passenger ferry services and facilities within the time framework of Artery/Tunnel Project construction. Careful coordination will be necessary between the Department, Artery/Tunnel Project contractors, the Coast Guard (through the Coast Guard Captain of the Port), the U.S. Army Corps of Engineers, the Metropolitan District Commission, Massport, and the Boston Harbormaster to insure safety, to provide for the orderly maintenance of marine operations in Boston, and to protect the marine environment. A Water Traffic Committee has been established by the Deparment for the project to provide for ongoing coordination.

Construction techniques and the choice of construction equipment will directly determine effects on navigation. For example, individual contractors will finalize construction schedules and determine the actual size and number of waterborne construction rigs. Contractors will also choose whether to ship construction supplies by land or by sea, while barge operators will determine the number and size of haul barges. In all cases, contractors will interface with the Coast Guard Captain of the Port and obtain final permission to commence construction activities.

Charles River. Construction activities in the Charles River include the erection of three new bridges across the river (I-93 northbound, I-93 southbound, and the Leverett Circle ramps), followed by the removal of the existing high bridge. Both operations will take place west of the Charles River dam and locks.

The bridge columns have been located to facilitate the flow of barge traffic in the Charles River. However, during the construction period, maritime traffic on the river will be disrupted, but allowed to proceed. For example, while cofferdam operations are underway near the main shipping channel, all vessels will be diverted away from the construction sites. Temporary construction shipping channels will be identified by the Coast Guard and the Metropolitan District Commission, who will interface with both the contractors and commercial shipping and pleasure vessel operators. Given the limited number and size of the vessels travelling through the area, temporary diversions will be simple to enforce and will pose no threat to the overall safety of maritime operations in the Charles River.

The final construction phase affecting navigation on the Charles River will be the removal of the existing high bridge. The bridge will be dismantled in sections, with the entire operation taking approximately 1 year. The contractors could work entirely from construction barges or from equipment located on the bridge itself. Debris and scrap metal from the bridge could be removed by barge, truck, or rail. Regardless of the techniques used, maritime traffic will have to be diverted when work is underway directly above the main shipping channel. Vessels will also have to be diverted around any stationary waterborne construction equipment. The high bridge dismantling operation will necessitate close coordination between the Artery/Tunnel Project contractors, maritime officials, and shipping operators. However, it will not affect the safety of shipping in the Charles River.

Fort Point Channel. Construction activities in Fort Point Channel include the tunnel box for the extension of I-90 and the erection of a temporary bridge immediately north of the existing Dorchester Avenue bridge, which will be removed. Following completion of the tunnel box and the construction of a new seawall, the temporary bridge will be replaced by a shorter, permanent structure. Although the temporary bridge will occupy space above navigable waters, this will have no effect on navigation in Fort Point Channel since the existing bridge marks the limit of navigation in the Channel.

The Third Harbor Tunnel crossing will be a complicated operation involving dredging and pier construction within gravity cofferdams, and the placing of immersed tube tunnel sections. The tunnel sections will be constructed nearby, and the operation will involve both land- and water-based construction equipment. To maintain drainage flows in Fort Point Channel, construction operations will never block the entire width of the Channel at any one time. However, construction activity may block the waters south of the tunnel crossing to possible barge traffic for considerable periods. This would affect only the Gillette Company which does not rely on barge traffic. Smaller power boats will be able to travel in the Channel at most times.

Boston Inner Harbor. The Third Harbor Tunnel will extend under the entrance to Boston Inner Harbor from the Subaru Terminal in South Boston to Bird Island Flats in East Boston. Construction will involve different stages and various construction equipment, each affecting marine traffic in different ways. For example, in all cases where stationary construction barges are used, the space consumed by anchoring lines will be greater than the dimensions of the barges themselves. Anchor lines will be marked clearly with buoys, and all ships travelling in the immediate vicinity of the barges will have to avoid the anchor line area, as well as the barges themselves. Some of the construction barges will be quite large, and together with their moorings will occupy a considerable amount of space.

During certain critical periods, construction barges will be moored in the Boston Main Channel. In most cases, ships will be able to navigate around the construction rigs. When diversions are necessary, special traffic control precautions will have to be taken to insure the safe passage of ships in and out of the Harbor. However, when construction work is obstructing the 40-foot depth lane, all ships will be diverted to the 35-foot depth lane, and it is possible that larger vessels might encounter tidal delays while navigating within the Inner Harbor.

Due to the Third Harbor Tunnel's close proximity to Logan International Airport, the height of all waterborne construction rigs will be limited. General Part 77 of FAA Air Regulations pose a 150-foot height limitation above airport elevation (18 feet) for a radius of 10,000 feet from the ends of all runways. As a result, construction contracts will state that no cranes or booms attached to waterborne construction equipment will rise more than 168 feet above MSL.

Dredging And Blasting: The initial construction phase will involve dredging a trench along the bottom of the Harbor in which the immersed tubes will be placed. This work entails normal dredging procedures and blasting of the Harbor's rock. The entire operation is expected to last 9 months to 1 year. Dredging work will be done from a stationary barge equipped with a clamshell rig. During working hours, a haul barge will also be moored by the dredge barge to receive excavated material.

Blasting operations will involve special equipment. Borings into the rock will be made from a drilling barge with four to five drilling towers. Later, explosive charges will be lowered into the borings by tube from the same barge. A separate barge outfitted with a crane and bucket will be necessary to remove blasted material from the Harbor floor. This rig will also be accompanied by a haul barge during working hours.

Blasting will be done in layers because the size of the charges will be limited in order to minimize seismic effects on adjacent structures and fish. Special consideration will be made to insure that vibration-sensitive operations at the General Ship Company will not be affected by blasting. Sensitive equipment on vessels moored at General Ship will also be taken into consideration. Monitoring and testing equipment will be installed prior to the start of the blasting program to ease harmful effects on the surrounding environment. Since blasting will be an ongoing procedure directly affecting marine traffic, the Third Harbor Tunnel contractors will work with Harbor officials to establish a set schedule defining where and when blasting will take place.

Once the blasting schedule has been approved, blasting will be conducted under closely monitored conditions with respect to the flow of maritime commerce in the area, safety of commuter boat and recreational vessel traffic, and potential impacts on marine life and water quality. These activities, as well as continued liaison with Harbor officials and permitting agencies, will be coordinated by the Project Mitigation Office.

Tunnel Foundation: Following completion of the tunnel trench, a foundation for the tube sections will be laid. One of two possible methods requiring use of a special trench preparation barge rig (screed) from which gravel will be placed along the alignment and then graded (the other method is a pumped sand option). The screed rig barge will measure approximately 60 feet by 120 feet and will be accompanied by a haul barge during working hours. It will take approximately 1 week to prepare the foundation for each tube section, and this foundation work will not be affected by water turbulence created by passing ships. Assuming these scheduling guidelines, construction equipment for the tunnel foundation will occupy the Boston Main Channel for approximately four 1-week periods, during which time ships will have to navigate around any construction rigs.

Immersed Tube Placement: The placing of the immersed tube tunnel sections will be the most sensitive phase of the construction period. Placing barges will occupy space on the Harbor surface, the tubes will be sensitive to water turbulence, and ships will have to travel at reduced speeds. When tubes are being placed beneath the Boston Main Channel itself, shipping activity in the channel may be temporarily curtailed.

Once the tunnel foundation has been completed, one tube section will be placed every 4 to 5 weeks. The tubes will be floated into place from where they have been outfitted, most likely near the East Boston or South Boston edge of the alignment, and will then be lowered from a large catamaran placement barge. The placement barge will measure approximately 170 feet by 350 feet and will be moored in the Harbor for as long as 2 days when each tube section is being lowered. Placement operations will be sensitive to water turbulence only while the tube sections are actually being lowered into the tunnel trench and during the initial phases of the underwater joining process.

Backfilling: The final construction operation affecting marine traffic in the Inner Harbor will be the backfilling of the immersed tube sections. Following the lowering of the tube sections into the tunnel trench, they will be joined to the previously placed tunnel structure, and secured in place with a rock and fill. Then, a two-phase backfilling operation will begin. The first phase involves covering the tunnel sections with a layer of sand, which will be placed in the tunnel trench using a vertical pipe equipped with a hopper. Then, the tunnel trench will be covered with a layer of protective crushed rock. The rock will probably be laid by a barge outfitted with a clamshell rig.

The equipment used for backfilling operations will be similar to those used for dredging work and will include a stationary work barge and haul barges bringing in backfill material during working hours. Backfilling operations should take approximately 1 week per tunnel section, and as a result backfilling work barges are expected to be moored at successive locations in the Boston Main Channel for approximately four 1-week periods.

Barge Traffic. To determine average daily barge traffic levels, estimates were made on the volume of excavated material that would be delivered to the various barge loading facilities. These estimates were made on a quarterly basis, and are based on the different construction activities underway around the barge loading facilities as work on the project progresses. Taking into consideration that two barge sizes may be used, this analysis indicates that barge traffic will peak during the first quarter of 1994, when a daily average of 12.0 barge loads of material will be removed.

Figure 20.25 presents a breakdown of the number of barge loads of excavated material produced per day at the various barge loading facilities for the duration of the project. Given that contractors will not produce the same amount of excavated material every day, it is assumed that the actual number of barge loads produced on a daily basis will fluctuate by 25 percent. As a result, the maximum number of barge loads of excavated material that would be expected during the peak quarter is 15. To translate this figure into the actual number of barge trips, it must be doubled, as barges will return to the Harbor after disposing their loads. Therefore, the maximum number of barge trips in Boston Harbor during the construction of the Artery/Tunnel Project will be 30 per day.

Dry Dock #3 in South Boston will be the most active barge loading facility and, together with the Fort Point Channel facility, will be in operation for the longest duration. The barge loading facilities in Bird Island Flats and the Charles River will be operational for approximately 3 years, while dredging for the Third Harbor Tunnel will span over 8 months.

Current commercial traffic levels in the Harbor are lower than levels common 50 years ago. At present, vessels navigate safely without the assistance of a traffic controller. Although overall tonnage passing through the Port of Boston may increase due to the increasing use of containerized freight and larger ships, arrivals in Boston Harbor are not expected to change appreciably in the foreseeable future.

On the other hand, passenger ferry services both public and private, regular route and charter, as well as recreational vessels are increasing. The peak period for all types of vessels is reported to be summer afternoons and evenings, due to high volumes of recreational vessels, which are largely unrestricted as to routes and schedules. The proposed introduction of five new ferry routes by 1995, if implemented, would increase traffic during specified periods and on defined routes.

In addition, the MWRA Boston Harbor cleanup project will extend from 1990 to 1999. Shipping will consist of six personnel ferry trips and a maximum of four barge trips per day. MWRA personnel ferries will not cross the paths of any anticipated Artery/Tunnel Project barge routes to Spectacle Island. However, MWRA barges travelling from Fore River to Deer Island will pass to the east of Spectacle Island, where they could encounter Artery/Tunnel Project barges.

While the Artery/Tunnel Project construction activities and barge movements will add to the current and projected levels of traffic in the Harbor, they are not expected to appreciably worsen navigation conditions. However, greater levels of coordination, monitoring, and operational control will be needed on a temporary basis during specified (scheduled) periods in order to maintain unimpeded, safe operation for all waterborne traffic.

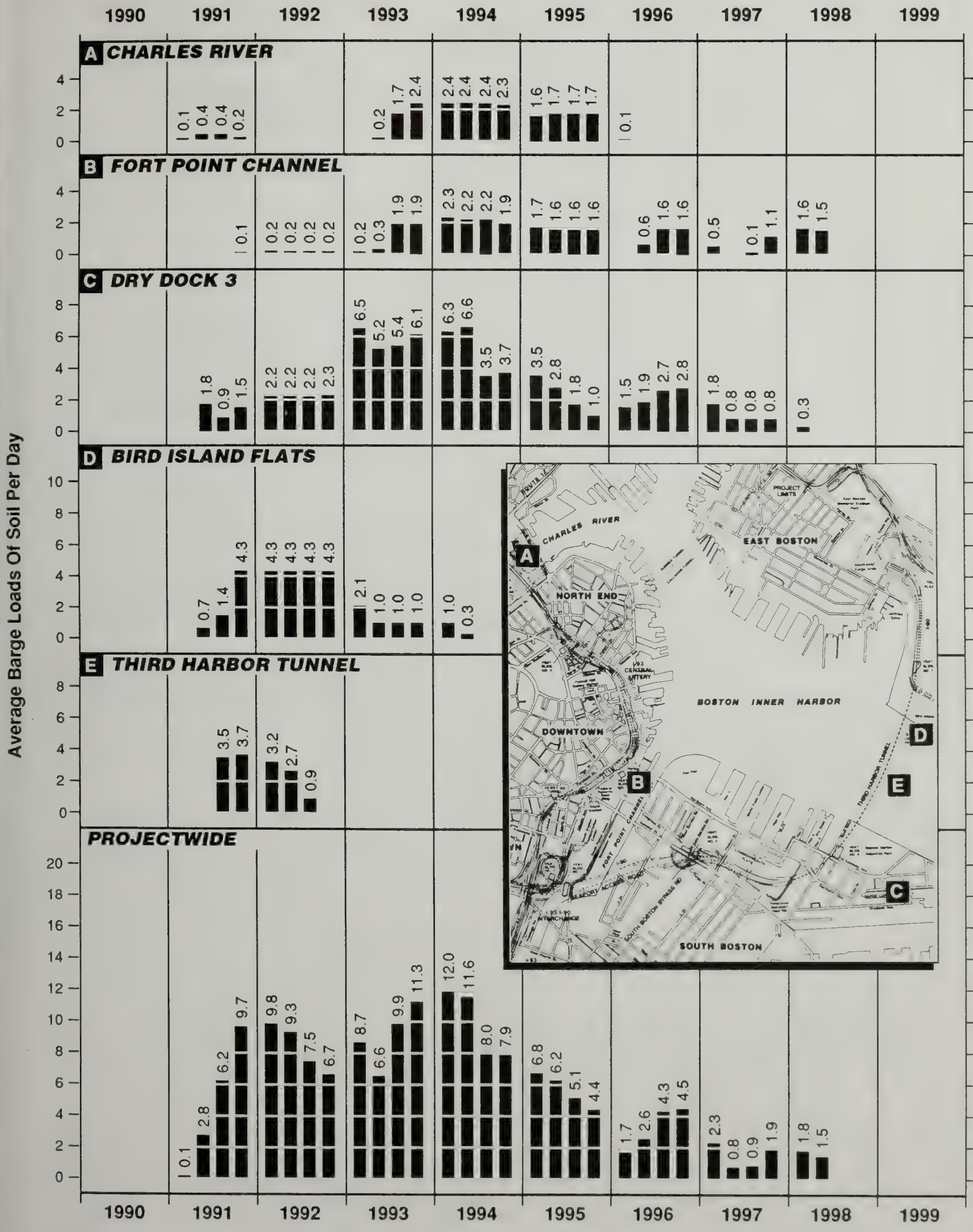
20.2.2 Economic Activity During Construction

This section summarizes the economic impacts of Artery/Tunnel construction on the local and regional economy. The overall economic impacts of the project, summarized in Table 20.1, are expected to be generally beneficial for the State, the region, and the study area. The benefits of job creation and increased spending resulting from the project should outweigh the temporary negative effects of construction activity on accessibility, retail trade, and tourism. Direct construction employment, construction spending, and successive respending of direct income will create an average of 8,900 jobs over the duration of construction. These workers and their families will increase the tax revenues of both the State and the City of Boston.

Retail trade in the region will benefit from increased spending by the new workers, which will offset possible losses in certain areas due to direct construction impacts. Retail trade in the study area is subject to a potential loss on the order of 0.5 percent, which can be avoided by an aggressive mitigation program by all the parties involved. Tourism is also subject to potential losses of somewhat less than 1 percent of total sales over the construction period, although such losses could be minimized by measures that maintain accessibility to downtown attractions and the City's reputation as a major destination for discretionary travel.

20.2.2(a) Construction Activity

The direct, indirect, and induced effects of construction on the Artery/Tunnel Project were estimated using an economic simulation model developed by Regional Economic Models, Inc. (REMI). (The REMI Model is described in Section 7.2.1.) The results of the REMI Model are shown for Suffolk County and the entire five-county New England County Metropolitan Area (hereinafter referred to as the "region") (see Figure 7.1). Figures are provided for the annual average and the peak year of construction activity.



FIGURE

20.25 **Barge Movement In Boston Harbor**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 20.1

SUMMARY OF ECONOMIC IMPACTS OF CONSTRUCTION[1]
(1987 Dollars in Millions, Jobs in Person Years)

Impact	Average Year	Peak Year	Total Construction Period
Total Employment (all sectors) (jobs)	8,900	15,100	71,000
Construction Employment On-site	2,600	4,500	21,000
Construction Employment Off-site	600	900	5,000
Household Income (direct, indirect, induced)	$ 410	$ 650	$ 3,300
Business Sales (direct, indirect, induced)	$ 610	$ 1,050	$ 4,850
Commonwealth of Massachusetts:			
Net Revenue	$ 3.4	N/A	$ 28

---

[1] Rounded values from later tables in this section

Source: Cambridge Systematics, Inc.

Direct Effects Of Construction. Over the construction period, it is expected that $4.4 billion will be spent on the depressed Central Artery and the Third Harbor Tunnel (see Table 20.2 and Figure 20.26). (Values are in 1987 dollars unless otherwise noted.) The net construction spending will total $4.1 billion, of which labor costs account for slightly over one-fourth, or $1.3 billion. This net construction spending will increase jobs and business activity in the region. Of the total $4.4 billion, approximately $321 million will be spent on acquisitions and relocation for right-of-way. These relocation and acquisition expenditures may provide needed capital and opportunities for increased sales at new locations for some affected businesses, although they may also result in some closures and reduced volume for other related businesses. These costs are considered to be largely economic transfers with negligible net economic impact. State assistance programs are available to help relocated businesses. These and other programs will be used to minimize potential migration resulting from the project.

The project will require 21,000 person years of direct labor on-site (see Figure 20.27). This is equivalent to an average of 2,600 persons employed full-time for the duration of construction. Figure 20.27 shows the on-site construction labor requirements by project year and indicates that 1994 will be the peak year of construction activity. Approximately 21 percent of the labor budget, providing 4,500 full-time equivalent jobs, will be expended during the peak year.

Total Effects Of Construction. The REMI economic model forecasts the overall change in employment and business sales that would be expected to occur in the region with and without the Artery/Tunnel construction. (Results for employment and sales are shown for Suffolk County and for the region in Tables 20.3 and 20.4.)

For the region, employment is projected to increase by an average of over 8,900 jobs per year over the construction period, peaking at 15,100 jobs. Household income (before tax) is forecast to increase by $413 million per year (1987 dollars), peaking at $648 million, and sales to increase an average of $607 million with a peak of $1.05 billion. The average increase in sales represents 0.2 percent of projected regional business sales.

The estimated net impact of the Artery/Tunnel Project on construction jobs for the average project year is an additional 1,790 jobs in Suffolk County and 2,670 over the entire region. The net increase in construction industry sales is estimated to be an average of $155 million per year over the construction period. Corresponding peak year levels are 4,580 net local construction jobs and $260 million of local construction business sales.

Services will have an average increase of 2,460 jobs, peaking at 4,100 jobs. Stone and clay manufacturing (including cement/concrete products) will grow by 960 jobs and $113 million per year in sales; corresponding peak year levels are 1,400 jobs and $168 million of sales. The rest of manufacturing, already a declining sector, is forecast to lose a small number of jobs (less than 60 net) due to wage competition for workers. Total personal income for all manufacturing employees, including stone and clay products, is forecast to increase by $29 million. The small employment loss in manufacturing outside of stone and clay products is due in large part to local manufacturers facing higher wages for their workers as a result of the greater demand for unskilled and semi-skilled labor for construction projects.

The Artery/Tunnel Project will create an average of $520 million of direct purchases per year over the construction period. The total increase in "final demand" -- regional

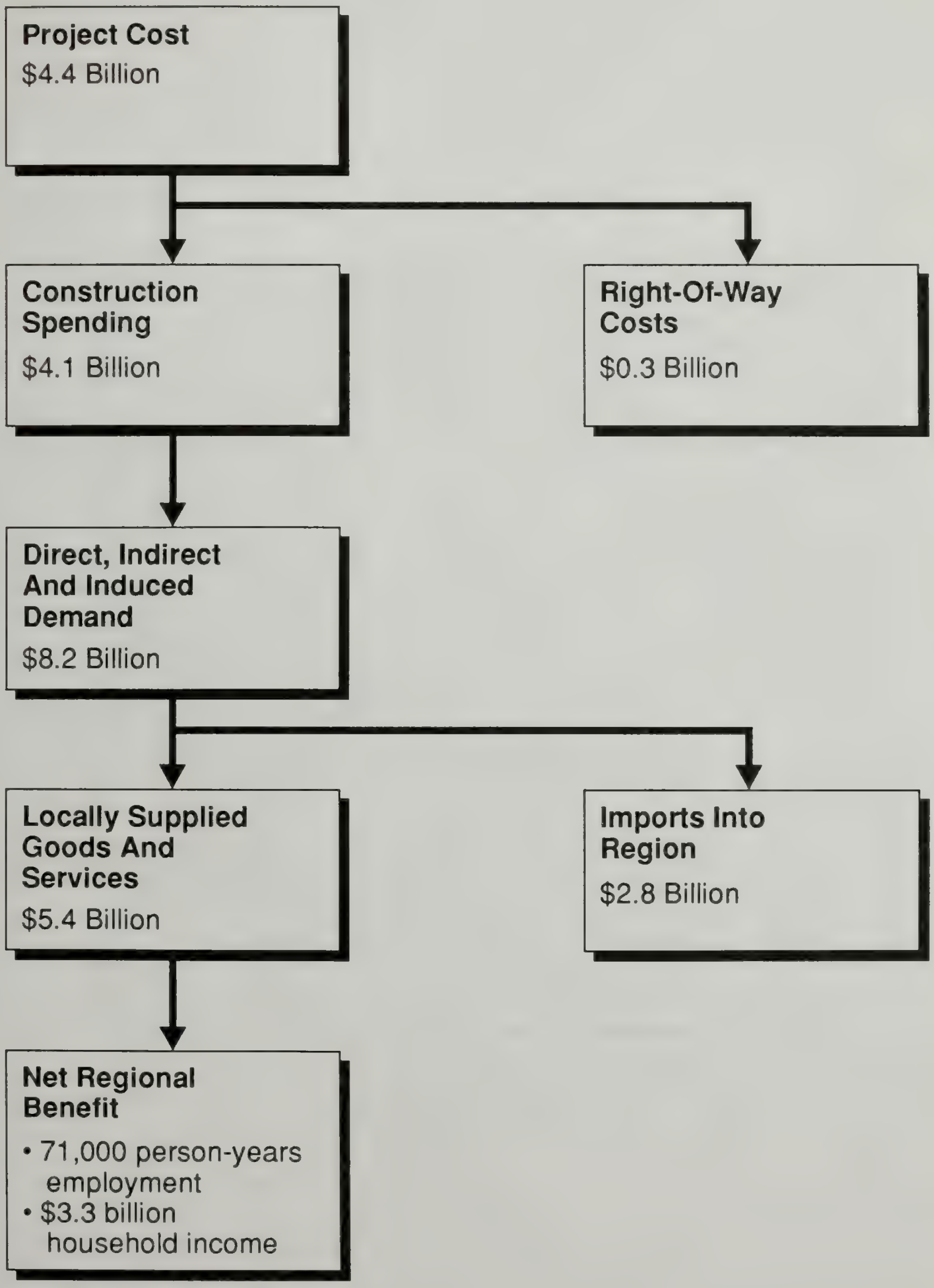
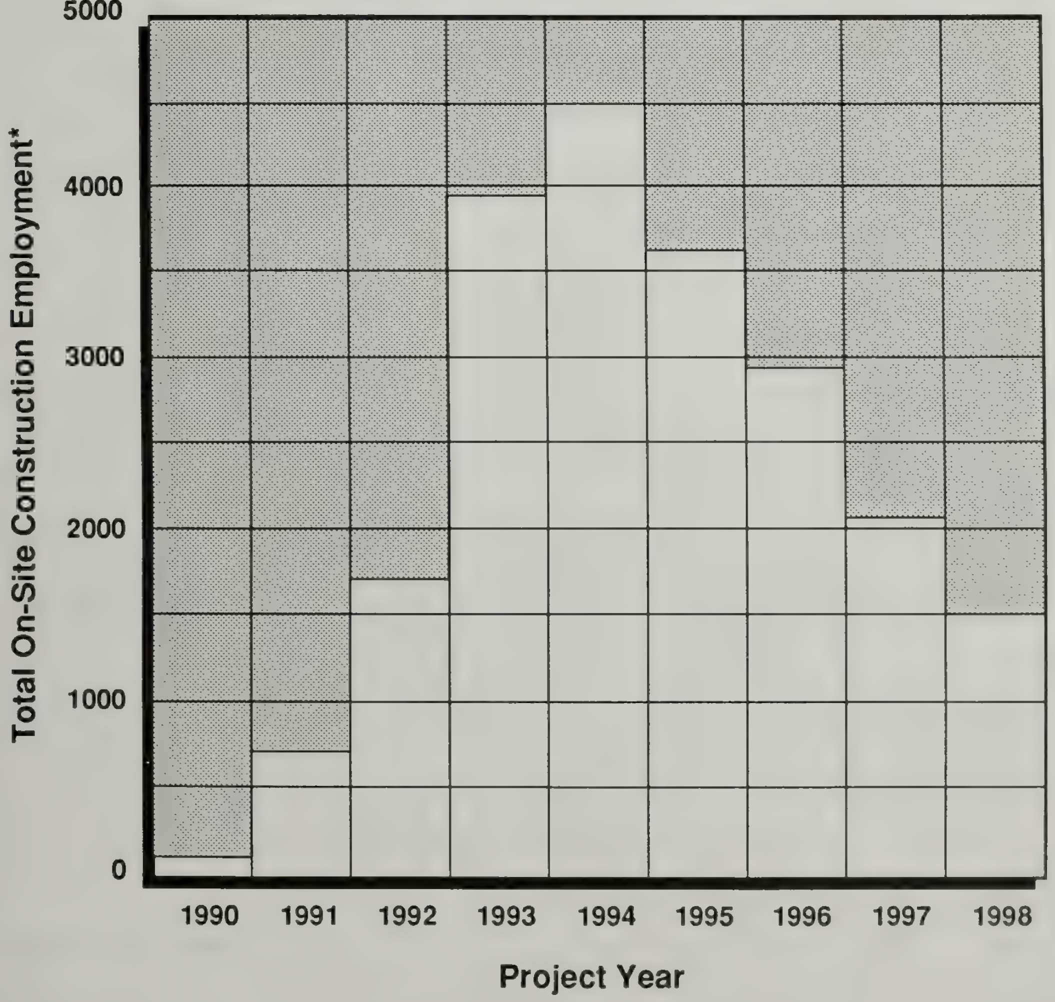


FIGURE
20.26 Estimated Construction Spending Impacts



* Employment is expressed in terms of full-time person-year equivalent; actual numbers of individuals will be higher.

FIGURE

20.27 **Construction Workforce**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Table 20.2

EXPENDITURES ON LABOR, MATERIALS, AND EQUIPMENT
(1987 Dollars in Millions)

Category	Labor	Materials/ Equipment	Total
Demolition	$22.0	$40.5	$62.5
Earthwork	273.7	625.5	899.2
Instruments	2.3	6.1	8.4
Utilities	32.4	86.5	119.0
Concrete	495.3	1,083.7	1,579.0
Immersed Tube	42.6	140.6	183.3
Ventilation	58.2	116.8	175.0
Structural Steel	26.7	124.4	151.1
Finishes	60.4	159.2	219.5
Railroad	7.6	19.0	26.6
Other	9.3	10.4	19.7
Contingency	154.6	361.9	516.4
Preliminary Engineering	110.7	36.9	147.6
Total Construction	$1,297.6	$2,816.6	$4,114.2
Acquisition and Relocation			321.4
Total Project			$4,435.6

Source: Interstate Cost Estimate, Bechtel/Parsons Brinckerhoff, 1989

Table 20.3

DIRECT, INDIRECT, AND INDUCED IMPACTS ON SALES AND JOBS IN SUFFOLK COUNTY

	Average Year		Peak Year	
Industry	**Change in Sales (1987 $, millions)**	**Change in Jobs**	**Change in Sales (1987 $, millions)**	**Change in Jobs**
Stone and Clay	$78.9	657	$109.0	915
Rest of Durable Manufacturing	-0.3	-15	7.5	23
Non-Durable Manufacturing	-1.0	-25	3.0	6
Mining	0	0	0.02	0
Construction	104.3	1,787	177.2	3,110
Transportation and Public Utility	36.5	165	61.7	299
Finance, Insurance, and Real Estate	60.9	382	93.5	620
Retail	16.2	440	26.4	741
Wholesale	12.9	144	22.4	261
Services	89.3	1,602	149.0	2,703
Agriculture/Fishing Services	0.1	1	0.1	2
Government	N/A	177	N/A	273
Total	$397.9	5,315	$650.3	8,954

---

1. N/A: Not available

Source: Cambridge Systematics, Inc. and REMI model

Table 20.4

DIRECT, INDIRECT, AND INDUCED IMPACTS ON SALES AND JOBS IN THE REGION[1]

	Average Year		Peak Year	
Industry	**Change in Sales (1987 $, millions)**	**Change in Jobs**	**Change in Sales (1987 $, millions)**	**Change in Jobs**
Stone and Clay	$112.6	958	$168.0	1,407
Rest of Durable Manufacturing	-1.6	-69	64.2	194
Non-Durable Manufacturing	5.8	13	16.6	94
Mining	0.8	1	1.3	2
Construction	155.4	2,667	260.1	4,580
Transportation and Public Utility	47.0	250	79.2	445
Finance, Insurance, and Real Estate	76.0	554	117.1	894
Retail	51.0	1,397	80.1	2,263
Wholesale	29.2	330	51.2	604
Services	128.8	2,459	212.3	4,095
Agriculture/Fishing Services	1.3	21	2.1	34
Government	N/A	364	N/A	531
Total	$606.5	8,925	$1,052.4	15,144

---

1. Essex, Middlesex, Norfolk, Plymouth, and Suffolk Counties
2. N/A: Not available

Source: Cambridge Systematics, Inc. and REMI model spending on goods and services as a result of the multiplier effect -- will average $1.03 billion per year over the construction period. Figure 20.28 shows the breakdown of regional spending by various economic sectors and shows the shares of regional impacts and self-supply for each sector. Businesses in the region will supply 66 percent of this demand (averaging $670 million per year) and the balance will be met by imports from outside the metropolitan area.

The impact on demand in the services sector will add $179 million per year, which includes engineering, other project-related services, and indirect and induced demand for many consumer-related services. The region will supply 72 percent of this demand ($129 million). Construction demand will average $178 million per year. Nearly all (87 percent) is expected to be met by local firms. (This is consistent with the views of union leaders and construction contractors expressed in recent interviews concerning the Artery/Tunnel Project.) Of the $171 million average demand for stone and clay projects (mainly cement and cement products), 66 percent will be provided locally ($112 million). The need for extensive earth-moving equipment and other demands for non-electrical machinery will be nearly $65 million per year. This will be met partly by imports, with local firms supplying 59 percent of these needs. Generally, most of the local demand in manufacturing industries will be met by imports from the rest of the country and the world. Conversely, the region will supply most of its needs for finance, insurance and real estate, retail, wholesale, transportation services, and public utilities.

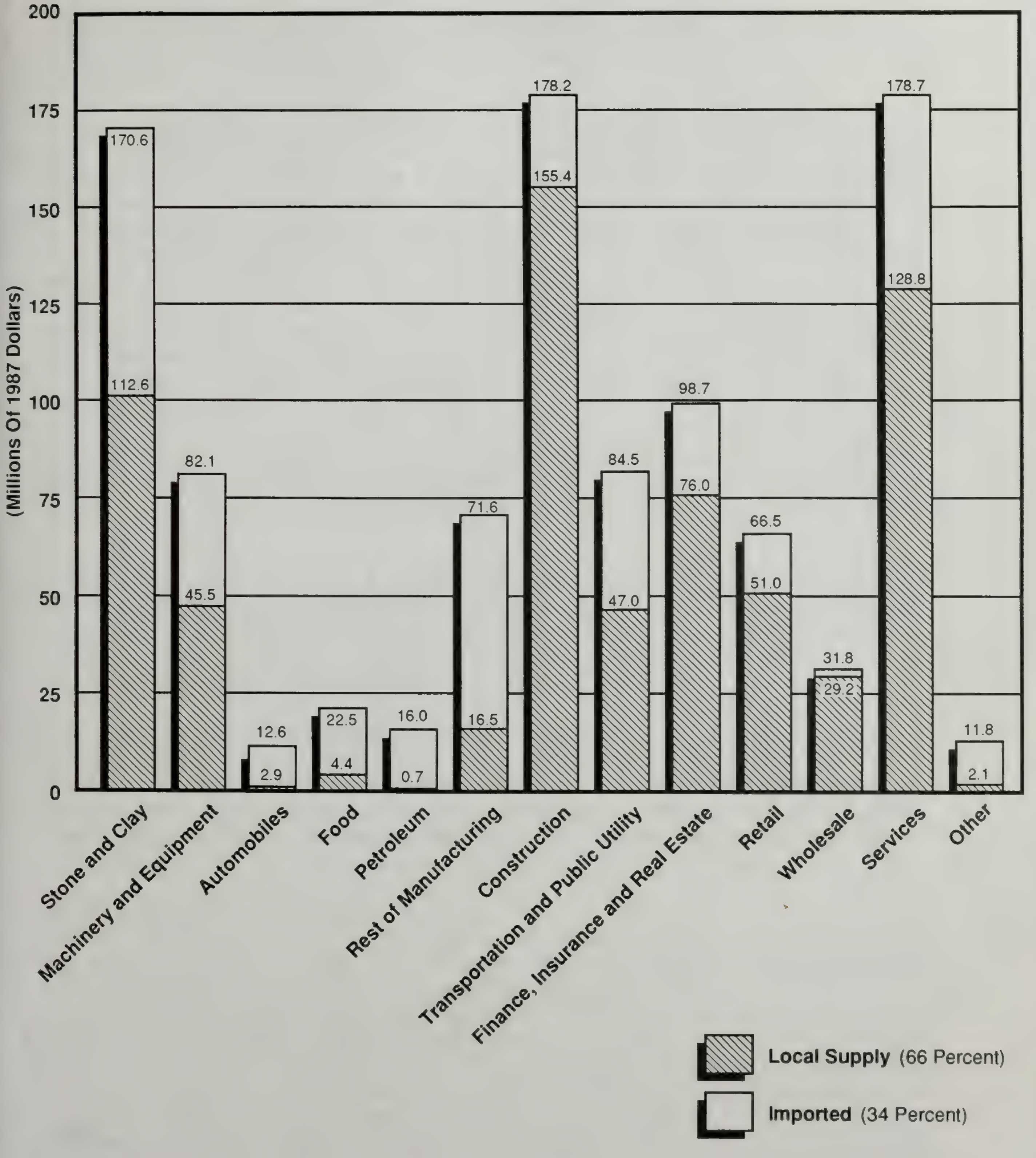
20.2.2(b) Office Market Impacts

There are no current signs that developers or investors are reducing their investment interest in the City in anticipation of Artery/Tunnel construction. They report that new projects are being planned and programmed treating the Artery/Tunnel Project simply as one variable among many in the planning and approvals process. This investor optimism is due in part to the belief that the traditionally long and stringent approvals process in the City leads to high quality and profitable development.

Projected Office Space. Office space projections for the years 1995 to 2010 indicate that the rate of growth for the study area is expected to slow to an average of 1.2 million square feet per year, for a total of 17.6 million square feet in the 15-year period. The projected slowing of the rate of office growth is due largely to saturation of the office market in parts of the City, as well as regional economic trends in general, and is not related to expectations of Artery/Tunnel construction impacts.

The Fort Point Channel/South Boston area has undergone a decline in private developer and tenant interest since the proposed Fan Pier/Pier 4 project was postponed and the Artery/Tunnel Project was announced. Development during the construction period will focus on the renovation of the stock of older warehouse buildings and on the proposed 20-story World Trade Center II project. Major new development is not expected to occur until after completion of the Third Harbor Tunnel and the planned local roadway improvements, when land use projections indicate a quadrupling of the existing amount of office space.

Property Values. Currently, the value of Boston office real estate continues to appreciate due to a variety of factors. A study by the BRA verifies that recently completed first-class office buildings have sold for amounts substantially greater than their development costs. Similarly, a number of factors (taxes, interest rates) could bring



Source: Cambridge Systematics, Inc. and REMI model

FIGURE

20.28

Average Annual Value Of Demand For Industrial Supplies Resulting From Construction

property values down, independently of the Artery/Tunnel Project. On the other hand, property values are also influenced by rental rates, which may potentially be impacted by the construction of the Artery/Tunnel Project.

It is possible that negative construction impacts (such as traffic congestion, noise, and loss of parking) could result in a decrease in demand for downtown space, which in turn could result in lower rental rates to keep downtown office space competitive. If construction resulted in a lowering of rental rates, then that portion of "value" which depends on rental rates could become lower as well during construction. On the other hand, if construction activity slows the development of new office projects, then the limited supply of new space may contribute to continued high rental rates.

Demand For Space -- Vacancy Rates/Absorption. Leasing activity and vacancy rates of individual buildings and of districts will vary during the course of the project, but the overall impact of Artery/Tunnel construction on downtown office vacancy rates is not expected to be significant.

It is anticipated that leasing activity in the South Boston/Fort Point Channel area, in particular, will be slow, and new projects should expect a longer leasing time because of the isolation from the rest of downtown and the necessity of crossing the Central Artery to reach the area.

City Of Boston Property Taxes. The increased population and employment expected as a direct result of the Artery/Tunnel Project will cause increased development of residential, commercial, and other space and will result in higher property tax revenue for the City of Boston. Based on current property tax levels, this increase is estimated to average $1.8 million per year over the duration of the project.

Suburban Impacts. It is highly unlikely that any of the major downtown tenants will move to the suburbs based solely on the Artery/Tunnel Project. Much of the anticipated movement of "back office" operations to the suburbs has taken place during the 1980s. The general opinion among brokers is that the major firms will remain downtown even under conditions of increased congestion during construction, because they perceive a need to be downtown.

20.2.2(c) Retail Business Impacts

Overall, it is expected that retail sales in the region will be increased by up to $51 million annually as a result of the additional retail purchases by Artery/Tunnel Project workers, employees of firms providing materials and equipment, and their families. However, some retail sales in the project study area will be at risk of loss during the construction period. The net loss to study area businesses is expected to represent approximately $10 million per year, which is less than 0.5 percent of the study area retail sales base. This loss results from a shift of some retail activity from the study area to elsewhere in the region. These findings are based on analysis of the retail sales contributed by various different retail market segments and evaluation of their sensitivity to car access, as well as from case studies of experiences elsewhere. (A detailed discussion is presented in the Construction Appendix.)

Business Turnover. It is important to note that in the course of any normal year, many retail businesses "turn over," i.e., go out of business or move to a new location.

This effect is a part of the retail marketplace and would occur whether or not the Artery/Tunnel Project was under construction. Past patterns suggest that over a 3-year period, 20 to 30 percent of the retail stores in the study area will disappear, to be replaced by others. Within the entire construction period, it would normally be expected that over half of the stores will change. Businesses are likely to respond to any changes in the marketplace by opening replacement stores in the area.

Localized retail impacts on established business districts, including Downtown Crossing, Financial District, Faneuil Hall/Haymarket, North End, Back Bay, and Chinatown, are described in the Construction Appendix.

Highway-Related Businesses. Traditionally, "highway-related" businesses are those businesses located on a highway which rely heavily on traffic from the highway for their customers. This includes such establishments as gas stations, fast food restaurants, and garages, all of which serve highway travellers. In the case of the Central Artery, there are no establishments on the highway, nor are there businesses dependent primarily on highway traffic for patronage. However, businesses within one to two blocks of the Central Artery, although not dependent on highway traffic for their business, may find their sales affected when construction is occurring immediately adjacent to their establishments.

Table 20.5 shows the estimated possible sales loss, averaging $7.4 million annually in impacts on adjacent businesses. As a percentage of total sales at all adjacent establishments affected by the construction project, the total loss would be 2.2 percent. A large share of this business will be recaptured within the study area by establishments farther away from the construction activity. Specific on-site mitigation measures, properly carried out, could further reduce these losses and transfers.

Direct Takings Of Businesses Due To Construction. The properties that will be taken for Artery/Tunnel right-of-way are summarized in Chapter 8. Most of the property is vacant or owned by the government, with only a few retail businesses and wholesale operations affected. Insofar as the vacant land is not developable in the short run and all businesses will be relocated or have the option to relocate, there is no net economic impact on number of jobs, income, and sales on a regional basis. The takings have a cost to the government in acquisition, relocations, and property tax loss. Acquisition and relocation costs are currently estimated at $321 million.

20.2.2(d) Industrial And Wholesale Business Impacts

There is a potential for negative impacts on manufacturing businesses in the study area during construction of the Artery/Tunnel Project as a result of limits on traffic circulation and access. Manufacturers rely on road transportation and access to and from the airport to ship their products. Several subareas contain concentrations of industrial activity, including South Boston/Fort Point Channel, South Bay/Newmarket/South End, and airport-related industries near Logan Airport in East Boston; these areas are likely to experience some degree of negative impacts as described in the appendix.

20.2.2(e) Residential Impacts

Overall demand for housing is expected to increase during the construction of the Artery/Tunnel Project. This will result in a general rise in rent levels and housing values, and cause a general decrease in vacancy rates. The only potential for demand to

Table 20.5

ESTIMATED LOCAL IMPACTS FOR ESTABLISHMENTS ADJACENT TO THE CENTRAL ARTERY

Industry	Total No. of Establishments	Potential Annual Sales (1987 $, thousands)	Average Year Sales Loss (1987 $, thousands)
Manufacturing	1	NA	NA
Transportation and Public Utilities	33	NA	NA
Wholesale Trade	96	NA	NA
Retail Trade			
Building Materials/Garden Supplies	11	$4,730	$ -118
Department Stores		0	0
Food Stores		50,700	-1,268
Gasoline Stations		5,658	-226
Apparel Stores		13,316	-333
Furniture/Home Furnishings	10	6,534	-163
Eating and Drinking Places[1]	176	91,835	-543
Miscellaneous	66	43,950	-1,468
Subtotal Retail	339	216,723	-4,119
Finance, Insurance, and Real Estate	124	NA	0
Services			
Hotels and Motels	2	8,078	-202
Personal Services	35	9,555	-233
Business Services	47	73,179	-1,962
Auto Services	16	17,328	-563
Miscellaneous Repair Services	5	1,365	-34
Motion Pictures	2	1,770	-44
Amusement/Recreation Services	8	9,632	-241
Health Services	15	NA	0
Education	1	NA	0
Family Services	2	NA	0
Engineering Services	1	NA	0
Subtotal Services	134	120,907	-3,279
GRAND TOTAL	727	$337,630	$-7,398
Percent of Sales at Establishments Affected			(2.2%)

---

1. 125 establishments are estimated to gain sales from construction worker spending

Sources: Business Inventory and Census of Retail Trade, and Cambridge Systematics calculations decrease substantially during the construction period, given existing demographic, income, and housing sales trends, would be if the study area office market weakened substantially and downtown workers left to find new jobs. Such impact is dependent on the general health of the Boston office market and the local economy rather than the Artery/Tunnel Project. This analysis of residential impacts is based on historic and current trends of housing sales and other data, described in Chapter 7.

20.2.2(f) Fiscal Impacts

This section describes the fiscal impacts of the Artery/Tunnel construction on the finances of the Commonwealth of Massachusetts. The average increase in annual State revenues during the construction period is forecast to be $25.3 million. Receipts from personal income taxes are forecast to increase by $15.0 million annually. State sales tax revenues are forecast to increase by $5.8 million per year. Business taxes and other fees, taxes, and departmental revenues are forecast to increase by $4.4 million (see Table 20.6).

State expenditures associated with construction consist of debt service on the State share of construction costs, which will average $21.8 million during the construction period. Thus, revenues brought about by the project during construction will exceed the early State costs of financing the project. (Long-term revenues will also exceed long-term expenditures, as described in Chapter 7.)

Revenue figures shown are annual averages for the entire construction period. Values for any given year during this period of time will differ from the average in proportion to the actual levels of employment and wages. Tax receipts are based on current tax rates. A detailed discussion of each revenue source is presented in the Construction Appendix.

Additional revenue will accrue to the State from tolls on new Harbor crossings after the Third Harbor Tunnel becomes available in 1995. However, toll revenues will be devoted entirely to initial operating and maintenance costs of the tunnels, so they were not included with the construction impacts.

Expenditure forecasts are based on borrowing the 10-percent State share of project costs (including both "hard" and "soft" costs) at 8 percent interest for 30 years. The figure presented is an average of 10 years' debt service costs, with debt incurred according to the current project schedule. Debt service costs in any single year will differ from this average. The rate and form for the borrowing assumed for this analysis are those prevailing today for similar tax-exempt, general obligation issues.

The average annual State revenues from income, sales, and other taxes generated by the expenditure of construction funds thus will exceed anticipated State expenditures for debt secured during the construction period by approximately 17 percent. When construction is complete, these debt service costs will be offset by revenues from changes in long-term employment, which are discussed in Chapter 7.

20.2.2(g) Impact On The Homeless

Potential impacts of the Artery/Tunnel construction on the homeless relate to issues of safety, housing affordability, and the locations of shelters and congregation points.

Existing trends in housing have been toward continued high-occupancy rates, with upward pressures on rents in much of the region. The Artery/Tunnel construction is likely to

Table 20.6

CONSTRUCTION PHASE
ANNUAL FISCAL IMPACTS: COMMONWEALTH OF MASSACHUSETTS[1]

	Amount (1987 $, Millions)
Revenues	
Personal Income Tax	$15.0
Sales Taxes	5.8
Business Income Taxes	0.6
Other Taxes and Fees	3.8
Total	**$25.3**
Expenditures	
Debt Service	$21.8
Total	**$21.8**
Excess (Deficiency) of Revenues Over Expenditures	**$3.5**
Ratio of Revenues to Expenditures	**1.16:1**

---

1. Average project year (8-year total period)
2. Revenue and expenditures are derived from the Cambridge Systematics Fiscal Impact Model; revenues are based on current (FY 1988) rates and schedules; see text for details

Sources: Cambridge Systematics, Inc.
Massachusetts Department of Revenue
Massachusetts Executive Office of Administration and Finance
Massachusetts Executive Office of Transportation and Construction

reinforce these trends, resulting in higher rents and house prices and possibly excluding low-income residents from some sections of the City. However, some low-income residents are likely to benefit from the increased job opportunities directly or indirectly associated with the project, so that the net effect of the project on housing affordability is mixed.

The Artery/Tunnel Project may affect the homeless by removing a place of shelter (under the Artery) and altering pedestrian travel patterns to and from formal shelters. Although there is a bed in Boston shelters for every homeless person who desires one, homeless advocates estimate that around 50 individuals use a variety of structures, including the Artery, for shelter. These people will relocate as a result of the Artery/Tunnel Project. In addition, the Rapid Service Press building has been used since its acquisition in 1987 by the Massachusetts Department of Public Works as a formal shelter housing around 300 men; an agreement with the Pine Street Inn, a nonprofit organization, permitted temporary use of the building as a shelter. Major utility work required for the project will require vacating the building in 1990.

Another potential impact is a possible shifting of the homeless among various congregation points. Currently, major congregation points are Downtown Crossing, Back Bay/Copley Place, Government Center, and South Station. With construction directly affecting South Station and the areas under the Artery, new congregation points may develop elsewhere.

20.2.2(h) Tourism

A small loss of tourism can be expected to the extent that accessibility to attractions located near the Central Artery is impaired by construction, and to the extent that outside visitors perceive Boston as a more difficult place to visit during construction.

The extent of these impacts will depend upon the success of planned mitigation measures in ensuring that:

- Adequate circulation within downtown is maintained
- Adequate parking (remote or downtown) and bus storage is provided
- A widespread publicity campaign informs the outside world that the City is still moving and provides information on access to all attractions during construction
- Adequate signage is maintained throughout the City

Mitigation measures can be expected to reduce but not entirely eliminate potential losses in tourist spending during construction. Overall, it is expected that the region will lose an annual average of $4 million in direct tourist spending, resulting in $7 million loss of total regional business sales, as a result of Artery/Tunnel construction. This represents a small fraction of 1 percent of the total of $2.26 billion in visitors' expenditures in the region. This effect is small enough to be potentially obscured by normal annual fluctuation influenced by the weather, the summer price of gasoline, the dollar's exchange rate, and the overall business cycle.

20.2.2(i) Impacts On Institutions

The major institutional impact of Artery/Tunnel construction will be on local area hospitals. Maintenance of traffic circulation and parking, along with careful coordination of construction projects, will be necessary to keep impacts on hospitals to a minimum. Although hospitals are nonprofit institutions, they need to attract employees and patients to survive financially. Thus, hospitals have concerns similar to those of businesses located near the Artery/Tunnel Project.

Based on interviews with major hospitals close to the Artery/Tunnel Project, it is expected that the primary construction period impact will be on accessibility for patients, employees, and ambulances during the Artery/Tunnel construction. If the area near a hospital gains a reputation for being congested or confusing due to construction (even if emergency access is not impaired), patients and employees might look elsewhere, eventually reducing revenues. This concern is greatest for hospitals such as Massachusetts General and New England Medical Center, which draw patients from all over the Northeast, than with hospitals such as Boston City and Spaulding Rehabilitation, whose patients primarily come from Boston and Greater Boston.

The most serious potential impact during construction is the possibility that ambulances will have time-consuming difficulty maneuvering around ramps, detours, extra traffic, and construction. Detailed communication with Artery/Tunnel operations will be required to reroute ambulances, as well as patients' and employees' vehicles, to lessen the severity of this potential impact.

Another perceived construction impact is loss of parking, which affects the hospitals' ability to attract employees and patients. Boston City and Boston University Medical Center will lose employee parking due to Artery/Tunnel construction and other development projects. Lack of parking is already a problem at all four hospitals, and although two of them are investigating programs encouraging vanpools, offering MBTA passes, and arranging carpools for employees, they expect parking to become even more difficult during the project. The Artery/Tunnel Project will work with the hospitals to provide alternate parking in the area (see Construction Appendix, Replacement Parking Program).

Other potential impacts include delays in receiving deliveries, making shipments, and expanding facilities. Massachusetts General Hospital has a satellite delivery station in Somerville so deliveries can be scheduled at off-peak times, but the other hospitals expressed the need for major routes to remain open so they could receive needed supplies. Other than trash, the hospitals do not make many shipments out.

New England Medical Center and Spaulding Rehabilitation Center are planning expansion projects during the Artery/Tunnel construction period. These need to be coordinated with the Artery/Tunnel Project in order to avoid additional congestion and confusion for employees and patients.

20.2.2(j) Local Impacts Of Construction

Potential construction period impacts on specific subareas within the Artery/Tunnel Project area are presented in the appendix. Each subarea is examined in terms of residential, office, manufacturing/industrial, retail and institutional activity, where applicable.

20.2.3 Utilities

The construction of the Artery/Tunnel Project will have a major impact on the many existing utility lines located within the proposed alignment. These utilities include major water, storm drain, sewer, gas, electric, steam, and communication lines. Wherever possible, existing utilities will be permanently relocated into specially dedicated corridors, where they will then be supported in place during construction. Where this is not appropriate, individual utility lines will be either temporarily relocated, permanently relocated in new alignments, or supported in place in their existing alignments. (Chapter 12 of this document identifies the extensive system of public and private utilities that will be affected by the construction of the Artery/Tunnel Project, while detailed descriptions of the individual relocations are contained in the Supportive Engineering Report.)

Generally, utility relocation work will not extend for prolonged periods of time. In the Central Area, utility work will be completed before the start of mainline construction under two separate contracts lasting 18 months. In other areas, utility relocation work will be carried out by mainline contractors, and in several instances construction contracts will stipulate that relocation work should be completed before the start of construction of roadway and tunnel elements. However, in circumstances where repeated excavation work would result in unacceptable levels of traffic congestion, utility work will be combined with general construction activities.

20.2.3(a) Scheduling And Service Disruption

The maintenance of continuous utility service is an important project priority. However, service disruptions -- both planned and unplanned -- are unavoidable. Planned disruptions will take place when crossover connections are made between newly relocated and existing facilities. The sequencing of utility work will be designed to ensure smooth crossover connections and keep such disruptions brief and to a minimum number. Scheduling for planned disruptions will be completed in accordance with the Artery/Tunnel Construction Management Plan, and will involve extensive coordination between project management, contractors, utility agencies, and customers. Gas and steam service will not be interrupted during peak use winter months, nor will electric power be cut during the summer. Any telephone shutdowns will occur during late-night, off-peak hours. Tidal conditions will also be considered when working with wastewater and storm drain facilities.

Unplanned disruptions due to breakage and construction accidents are inevitable during the course of an undertaking as massive as the building of the Artery/Tunnel Project. However, they will be kept to a minimum for two important reasons. First, as a result of the detailed design work for the project, major utilities running within the alignment have been located and carefully mapped. More is known now about the exact locations of individual utility lines within the project area than at any time in the past, and, before contractors start their work, they will be provided with detailed information on all major utility lines.

In addition, most major utility lines will have been physically relocated and, wherever possible, consolidated into joint corridors prior to the commencement of mainline construction. With utility lines already out of the way, construction accidents will be further minimized. In addition, utility lines running in the corridors will be supported in an open space which will facilitate continuous inspection and easy access if repairs have to be made.

While these measures will be effective in preventing accidental breakages, a detailed reaction plan will also be established to expedite repair work if and when such accidents do occur. A hotline will be established to ensure 24-hour communication between project management, contractors, and utility operators in the event of emergencies. In addition, utility operators will be provided with detailed schedules and will be informed of any changes before construction activities actually begin.

20.2.3(b) Traffic Control And Special Coordination

Traffic congestion caused by utility relocations will be an important issue in some locations. Wherever possible, congestion levels will be reduced by concentrating utility work during off-peak traffic hours. Potential traffic congestion will also be controlled through extensive communication and coordination with utility operators, abutters, and other agencies undertaking other ongoing or planned projects.

There are certain locations throughout the project where complicated construction concerns or space limitations may require special coordination between the Department, Artery/Tunnel Project engineers, utility operators, and abutters. In such cases, construction plans may have to be carried into more minute detail than is common in a normal design process. Such detailing will allow those involved to investigate all the ramifications of various construction alternatives and choose appropriate options. One notable case where such early detailing has been already necessary is the area surrounding the International Place temporary ramp.

20.2.3(c) Area North Of Causeway Street

The major utilities affected by the Proposed Action in the Area North of Causeway Street are located south of the Charles River in the mainline abutment and I-93 bridge approach area, and in the Leverett Circle/Storrow Drive area. Major utilities in conflict with new roadway structures will be relocated permanently. However, some minor utilities may require temporary relocation. Both previously existing and newly relocated lines will be supported in place above construction areas wherever necessary. Given that all project roadways north of the Charles River will be either at grade or on elevated structures, no major utilities relocations are anticipated in Charlestown or Cambridge at this time.

20.2.3(d) Central Area

Existing utilities traverse the Central Area and will conflict with tunnel, ramp, and temporary underpinning structures in many locations. These various utility lines will be reorganized into permanent transverse and longitudinal utility corridors. Longitudinal corridors will be located outside the project alignment wherever possible, to avoid conflict with underground structures. Transverse and longitudinal utility corridors located within the alignment will be constructed at lower depths, to avoid conflict with existing utilities or decking and grade beams, which will be installed later in the construction process.

Figure 20.29 illustrates the various phases involved in relocating utility lines into combined corridors in the Central Area. Before work can begin on tunnel structures, the corridors will be built and the new utility lines installed beneath existing facilities (phase 1). Once the new lines are linked with existing networks outside the construction area, excavation and slurry wall work can begin. During the construction period, the relocated utilities will be supported in place by a temporary road framing structure, as work on the tunnel structures proceeds below (phase 2). After completion of the tunnels, the framework structure will be removed and the corridors will be filled in, with the utilities permanently in place above the roadway alignment (phase 3). In some cases, portions of slurry wall panels will be installed prior to phase 1 to avoid inevitable conflicts between utility lines and tunnel structures.

In some situations where utility corridors run inside the construction area, early relocation may not be desirable. Where such conditions exist, it is often less disruptive to combine utility relocations work with mainline construction contracts. At some locations, utility routes will actually be built into the tunnel structures themselves because of severe clearance constraints.

20.2.3(e) I-93/I-90 Interchange And Massachusetts Avenue Interchange Area

There are several major utility relocations within the I-93/I-90 Interchange area that will be affected during construction. Among these are:

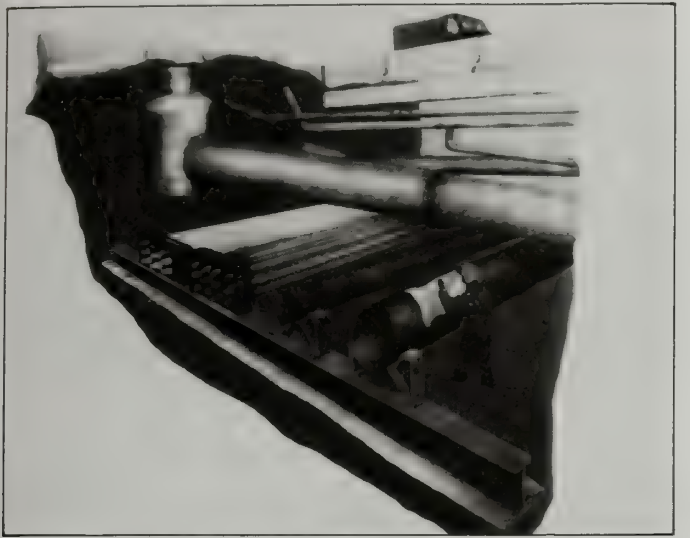
- New East Side Interceptor, within the South Station railroad yards and adjoining roads
- Massachusetts Turnpike Authority (MTA) pump house 7 and related force mains within the I-93/I-90 Interchange
- Force main draining the railroad property
- Gas line from Herald to Kneeland Streets
- Combined sewer from Albany Street to Fort Point Channel
- Gillette cooling water intake structure, fuel tank, and resin tanks, all on the east bank of Fort Point Channel
- Two combined sewers and a storm drain at North Washington Street

Relocation work on the New East Side Interceptor is scheduled for early construction. Some of the remaining utilities will be relocated as a first priority at the start of construction and later will be surrounded by construction activities. Access to these facilities will be maintained during construction.

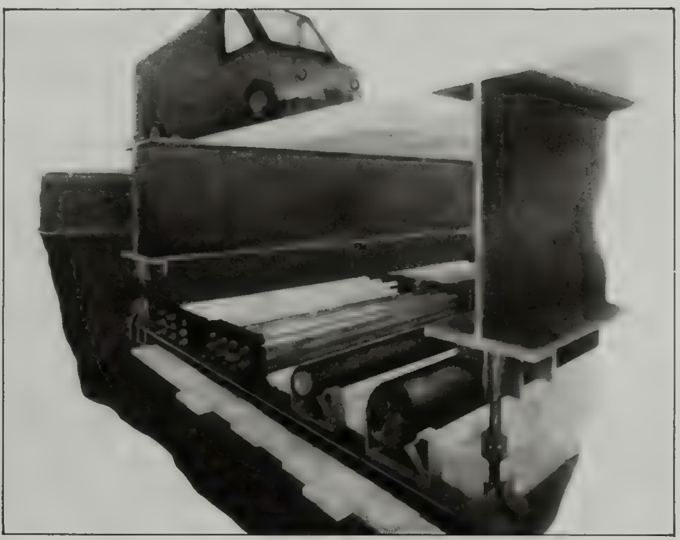
20.2.3(f) South Boston Area

In South Boston, local utility crossings will present the most difficulty in the Summer Street area, due to the width of the I-90 extension and the oblique angles at which the utility lines will cross the roadway. Local utility lines include: water lines, a gas line, two oil-filled pipes carrying 115 kV service, and various telephone and electrical ductbanks. These utilities will be diverted along the north side of the boat section and cross the I-90 alignment at C Street on a utility bridge.

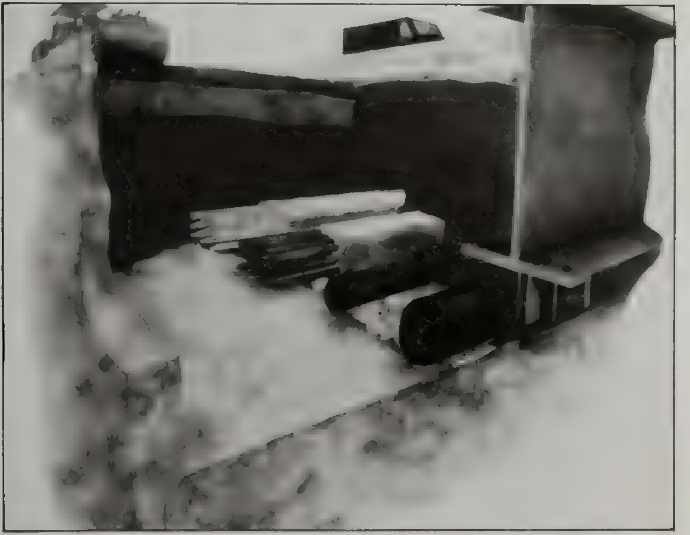
An existing sanitary sewer located near Turner Fisheries and several of its connecting lines will be relocated to a new crossing near Northern Avenue. Other smaller utilities at Fid Kennedy Avenue, Northern Avenue, and additional locations will be supported in place or relocated across the I-90 alignment. The General Ship Company steam plant adjacent to the seawall will be relocated permanently.



Phase 1 New utility lines are placed in the corridor below existing facilities.



Phase 2 Utility corridor supported in place with tunnel construction proceeding below and vehicular traffic running on deck structure.



Phase 3 Following completion of mainline construction, utility corridors are backfilled, with new lines in their permanent positions.

FIGURE

20.29

Typical Transverse Utility Corridor

20.2.3(g) East Boston/Logan Airport Area

In East Boston, major utility relocations will be necessary to avoid conflicts between the I-90 mainline tunnels and the Porter Street outfall, the underground hydrant fueling systems for Pan American and Eastern Airlines, and numerous smaller utilities. The Porter Street outfall will be relocated parallel to and under Harborside Drive, to avoid crossing the tunnel alignments. The two fuel farms will be relocated as a part of the reconfiguration of the entire airport fueling system. The pump station and electrical substation will be relocated. Other utilities crossing the I-90 alignment will be temporarily supported in place or relocated to avoid roadway structures.

20.2.4 Air Quality

This section summarizes the construction-related air quality impacts of the Artery/Tunnel Project, including the effects of:

- The detouring and disruption of traffic that will occur during construction of the project (mobile source-related impacts)
- Demolition, land clearing, grading, materials handling, and other earthworking activities
- Concrete batch plant in East Boston
- Removal of the existing viaducts and bridges

These impact assessments are based on currently available construction plans, maintenance of traffic plans, and traffic volume estimates, and include a comparison of anticipated project-related impacts against applicable State and Federal Ambient Air Quality Standards (AAQS) and criteria, and identification of measures to mitigate adverse project-related impacts.

20.2.4(a) Mobile Source Emissions

As described in Chapter 4, carbon monoxide (CO) is the principal pollutant of concern when considering localized air quality impacts of motor vehicles (automobiles, vans, trucks, buses, and motorcycles). Since emissions of CO from motor vehicles increase with decreasing vehicle speed, disruption of traffic during construction, due to detouring of traffic, the temporary reduction of roadway capacity, or the generation of increased queue lengths at crowded intersections could result in elevated concentrations of CO.

Increases in CO levels will occur both regionally, due to a temporary decrease in the general roadway level of service in the area, and at particular locations, due to increased traffic volumes and higher levels of congestion during construction of the Artery/Tunnel Project. Increased vehicular congestion could result from:

- Reduction of roadway capacity due to elimination or narrowing of travel lanes or street closings
- Detouring of traffic to less direct routes or routes with less capacity

- Deliveries of heavy construction materials

- Movements of construction-related vehicles and the private automobiles of construction workers

Construction impacts are temporary. The probability that assumed worst-case traffic conditions will occur simultaneously with worst-case meteorology decreases with decreases in the duration of the construction period. The majority of the 34 traffic conditions identified for potential mitigation planning will be less than one year in duration. Also, they will occur during different time periods at widely dispersed locations over the 9-year construction period. Many detours will likely change in configuration as construction progresses. Given the nature of temporary construction related traffic disruption, mitigation planning is essential in order to minimize effects on air quality and the environment, design the most efficient detours, and possibly eliminate detours and temporary traffic disruption conditions, if more desirable alternatives can be found. Appropriate mitigation strategies and measures to minimize impacts on air quality will be developed and adopted prior to construction.

An assessment of the impact of systemwide, site-specific and cumulative traffic conditions will be conducted during final design, as part of the construction mitigation and maintenance of traffic programs described in the appendices. Construction period traffic estimates are currently being developed. Once construction staging plans have been finalized, estimates of CO levels will be completed for locations where major construction-related impacts are anticipated to occur. The proposed procedure for this analysis will be consistent with the procedures used in assessing operational impacts and is outlined in the Maintenance of Traffic Plan Appendix.

20.2.4(b) Stationary Source Emissions

There are two principal types of emissions from construction-related stationary sources: fugitive emissions, including dust particles generated by major construction activities (demolition, excavation, grading, debris removal, and removal of viaducts and bridges); and gaseous emissions caused by the operation of such construction-related equipment as compressors, cranes, and generators. The impacts of fugitive emissions and construction equipment are described in the following discussion:

- Fugitive dust sources: Fugitive dust is airborne particulate matter, generally of a relatively large particulate size. Construction-related fugitive dust emissions may be generated by truck traffic on unpaved roads in construction areas; earthworking activities including excavation, grading, and demolition; and concrete batch plant operation.

- Fugitive emissions from removal of viaducts and bridges: Removal of these structures could require sandblasting, with the consequent generation of lead-laden fugitive dust.

Fugitive Dust Sources.

Truck Traffic And Earthworking Activities: Fugitive dust will be generated by haul trucks, concrete trucks, delivery trucks, and other vehicles moving around the construction sites. This will be due primarily to particulate matter that will be resuspended by vehicle movement over paved and unpaved roads and other surfaces, dirt tracked onto paved surfaces from unpaved areas at access points, and material blown from uncovered haul trucks.

Earthworking activities that could generate fugitive dust include: excavation of the first 10 feet of the surface layer and cutting of tunnel trenches; scraping and grading of roadbeds; load-in/load-out of haul trucks with excavated material, demolition wastes, and backfill; and storage of excavated materials at barge loading facilities. (Table 20.7 lists the expected number of truck trips to and from each of the six construction areas, based on the amount of materials to be handled over the lifetime of the project.)

Generally, the distance that particles will drift from their source depends on the size of particle, emission height, and wind speed. Most fugitive dust is made up of relatively large particles (i.e., particles greater than 100 microns in diameter). These particles are responsible for the reduced visibility often associated with this type of construction. Given their relatively large size, these particles tend to settle to the earth within 20 to 30 feet of their source. Smaller particles (30- to 100-micron range) can travel several hundred feet before settling to the ground, depending on wind speed. Particles less than 30 microns in size tend to travel even farther.

Emission heights will be relatively close to the ground. For example, dirt tracked onto paved areas and resuspended by traffic will become airborne in the lowest few feet above the ground. Dust generated by traffic on unpaved roads will have an effective emission height that is somewhat higher, since it will be entrained in the wake of the vehicles.

Dust generated during a material load-in and haul-out will have emission heights comparable to the height of the haul trucks. In some cases the emissions will be generated below the ground surface (e.g., for cut-and-fill operations). Based on their relatively large size and low emission heights, impacts of fugitive dust are expected to occur relatively near to the construction sites under most meteorological conditions.

Impacts from concurrent activities along the project alignment should not tend to combine to create unacceptable effects, since activities will generally be spread over the 7-mile project alignment. Emissions are expected to occur principally during construction hours (7 AM to 11 PM), except for peak construction periods in some areas. Project-related emissions will be minimal during other hours (i.e., there will be less project-related particulate matter impact for about two-thirds of the day). In addition, construction activities will generally take place during daytime hours characterized by greater atmospheric turbulence and better pollutant dispersion than during nighttime hours. However, in some instances and at certain locations, second and third shifts will be added to maintain the project schedule.

Demolition: Dust emissions resulting from the removal of existing structures along the alignment have the potential to impact local air quality. These emissions can result from such demolition methods as the use of explosives, wrecking ball and crane, jackhammers, and sandblasting. The amount and duration of fugitive emissions that are generated from such activities depend on the structure to be removed, and the method of demolition used.

Major demolition activities that will be carried out during construction of the Artery/Tunnel Project include:

Table 20.7

TRUCK REQUIREMENTS BY SUBAREA
(Truckloads Per Day)[1]

Subarea	Years From Start Of Construction								
	1990	1991	1992	1993	1994	1995	1996	1997	1998
Area North of Causeway Street									
Average	30	20	10	10	40	50	30		
Peak		40	20	10	10	50	60	30	
Central Area (North to Causeway)									
Average		20		130	340	250	90	40	40
Peak		20		160	440	320	130	60	60
Central Area (North to Kneeland)									
Average		*	20	200	550	460	240	140	180
Peak		*	20	260	700	630	300	180	220
South Bay/Fort Point Channel									
Average			*	130	330	440	350	330	130
Peak			*	180	450	600	470	440	170
South Boston/Third Harbor Tunnel									
Average		110	290	610	490	350	80		
Peak		130	370	820	650	470	100		
East Boston/Logan Airport Area									
Average		160	530	290	210	50	*		
Peak		200	670	390	290	80	*		

---

1. Assumes 10-wheel dump trucks; excavation quantities are based on the Proposed Action; concrete quantities are based on Working Alternative 2.0 (ICE); backfill quantities are based on Working Alternative 3.0
2. Less than 5 truckloads per day

Source: Bechtel/Parsons Brinckerhoff, June 7, 1989

- Area North of Causeway Street: Demolition of the Anelex building at 150 Causeway Street, and the Boston Sand & Gravel maintenance building, associated steam plant, and the partial demolition of the north warehouse owned by Guilford Industries.

- Central Artery: The removal of the existing Artery structure. This will be accomplished by cutting or breaking structural members into manageable pieces for removal by truck. The icehouse at the rear of the Boston Thermal steam plant will also be demolished.

- I-93/I-90 Interchange: The Rapid Service Press building will be demolished to provide space for a laydown/staging area and later construction of I-93. An abandoned fuel tank located along the tunnel alignment near the east bank of Fort Point Channel will be removed. The Castle Metal Company building will also be removed, and some demolition will be required at the existing Boston Edison substation near Southampton Street.

- South Boston: Some demolition of structures along the right-of-way will be required for the construction of the Seaport Access Road. This will include six buildings, a steam plant, and portions of elevated Summer Street and Viaduct Street bridges.

- East Boston: In the Bird Island Flats area, the Eastern Airlines hangar and fuel and air freight facilities, the Hill Air facility, and the Alamo and National Car Rental facilities, will be demolished. Portions of the existing I-90/Route 1A will be removed as project segments are completed. In the Logan Airport North Service Area, the Pan Am fuel facilities, a Citco gas station, the North Cargo building, the Cargo Trex building, the United Air Flight Kitchen, and several buildings in the Robie Air park will be demolished.

Generally, the distance that particles will drift from their source depends on the size of particle, emission height, and wind speed. Most fugitive dust is made up of relatively large particles (i.e., particles greater than 100 microns in diameter). These particles are responsible for the reduced visibility often associated with this type of construction. Given their relatively large size, these particles tend to settle to the earth within 20 to 30 feet of their source. Smaller particles (30- to 100-micron range) can travel several hundred feet before settling to the ground, depending on wind speed. Particles less than 30 microns in size tend to travel even farther.

Removal/demolition of the above structures will result in short-term increases in particulate matter levels in the immediate vicinity of the structures. Since these demolition activities will be brief, they will not pose a threat to long-term ambient air quality levels in the area.

Concrete Batch Plant: A temporary ready-mix concrete batch plant will be used to supplement concrete production from other sources for the Artery/Tunnel Project. This 200-cubic-yard/hour plant will be located adjacent to the project construction corridors in East Boston, and will store, convey, measure, and discharge water, cement, fine aggregate (sand), and coarse aggregate (gravel, crushed stone) into trucks for transport to the project site. Particulate matter, consisting primarily of cement dust, some aggregate, and sand dust, will be generated during these operations. Fugitive sources include the transfer

[BLANK PAGE]

of sand and aggregate, truck loading, mixer loading, vehicle traffic, and wind erosion of sand and aggregate storage piles. The plant will be designed and operated with controls consistent with the normal practice of existing facilities in the Boston area, including bag filters, covered conveyor system, and watering for dust control.

Emission factors for concrete batching developed by EPA were used to estimate the dust emissions from this plant. EPA-approved modeling procedures using the Industrial Source Complex Short-Term (ISCST) air quality model were applied to estimate the short-term 24-hour ground level particulate concentrations from operation of the concrete batch plant. The results of this analysis indicate that the 24-hour peak fine particulate matter (PM-10) ground level concentration from the plant will be less than or equal to 68 micrograms per cubic meters (ug/m^3). Existing (background) levels of PM-10 must be added to the contribution from the batch plant to determine total PM-10 levels in the vicinity of this facility.

The second highest 24-hour average total suspended particulate (TSP) matter levels recorded during the period 1985-1987 at the monitor located at Bremen Street in East Boston was used to estimate existing (background) levels of particulate matter in the vicinity of the proposed concrete batch plant (see Table 20.8). Both TSP and PM-10 pollutants were measured at one monitor located at Columbus Avenue during 1986 and 1987. The ratio of PM-10 to TSP measured at this location was 0.38 for 1986 and 0.41 for 1987. Based on these observed ratios, background PM-10 levels have been conservatively estimated to be 42 ug/m^3, half of the TSP levels recorded at the Bremen Street monitor. Adding the estimated PM-10 background value of 42 ug/m^3 to the peak PM-10 value of 68 ug/m^3 calculated for the contribution of the batch plant, the maximum PM-10 levels in the vicinity of the batch plants are expected to be 110 ug/m^3. This is well below the 24-hour NAAQS level for PM-10 of 150 ug/m^3.

On an annual basis, the batch plant is expected to operate less than 50 percent of the time during the project construction period. Assuming half-time operations, the maximum annual contribution of batch plant operation to TSP levels is estimated to be 17 ug/m^3. Based on the 3 years (1985 to 1987) of monitoring data at the representative site in East Boston, the annual average TSP concentration for the area will be 48 ug/m^3. Maximum annual average TSP levels in the vicinity of the batch plant will therefore be 65 ug/m^3 (17 ug/m^3 contribution from the batch plant plus 48 ug/m^3 background levels). Maximum expected PM-10 levels, assuming 50 percent of TSP levels, would be 33 ug/m^3. This is within the annual National Ambient Air Quality Standard for PM-10 of 50 ug/m^3.

Other Sources Of Fugitive Emissions. Viaducts and bridges to be removed during the construction phase of the Artery/Tunnel Project have been protected from the effects of the environment by lead-based paints. Since these structures have been riveted, they will have to be removed by cutting structural members into manageable sections using acetylene torches. To prevent the release of lead fumes, the structure will be sandblasted under controlled conditions to remove lead-based paint prior to cutting with acetylene torches. This could result in the release of lead paint particles into the atmosphere. With controls, these particles will be monitored and contained. Section design and construction contracts will incorporate requirements for using the best available controls during the removal of structures.

Table 20.8

BACKGROUND TSP[1] LEVELS FOR CONCRETE BATCH PLANT
(ug/m^3)

Time Averaging Periods	Data Periods	Monitor		
		East Boston		Dorchester
		Public	Private	
24-hour (Second highest)				
	1985	99	82	67
	1986	89	79	83
	1987	103	81	73
	Overall Average = 84			
Annual (Arithmetic Mean)				
	1985	55	51	40
	1986	54	43	37
	1987	62	49	42
	Overall Average = 48			

---

1. TSP: Total suspended particulates

Source: Massachusetts DEP annual air quality data reports

Gaseous Emissions Sources. Gaseous emissions of concern include CO, NO_x, SO_2, and VOC which may result from operation of construction equipment or the concrete batch plants.

Construction Equipment: A wide variety of equipment will be used to construct the project, ranging from 200-ton cranes to jackhammers. Since construction plans have not been finalized, no definitive estimate can currently be made of the specific number, types, periods of operation, and locations of all construction equipment. However, two principal factors indicate that air quality impacts due to exhaust emissions from construction equipment will be minor. The major pieces of equipment, including cranes, trucks, excavators, and welding machines, are diesel-powered and are not significant emitters of carbon monoxide, the principal pollutant which could cause localized impacts on air quality. Due to the staging and sequencing of construction, most equipment will remain at one location for relatively short periods, greatly reducing the potential for long-term exposure at any particular location.

Concrete Batch Plant: The concrete plant will use a 30,000-gallon boiler to produce hot water for cement mixing. The plant will operate boilers about 12 hours per day, 5 months per year. Based on pollutant emission estimates developed by the U.S. Environmental Protection Agency (USEPA AP-42), for a commercial oil-fired boiler of this size, the estimated pollutant emissions from burning No. 2 oil are summarized in Table 20.9. These estimated emissions indicate that the pollutants generated by the oil-fired boiler will be less than EPA criteria for determining significant levels of emissions (e.g., sulphur dioxide emissions, 3.1 tons per year, will be less than 8 percent of the EPA significance level 40 tons per year). Based on these results, the air quality impacts on nearby areas are expected to be insignificant and within applicable health- and welfare-related standards.

The concrete plant can produce 200 cubic yards of concrete per hour. This would require up to 20 trucks entering and leaving each plant site per hour of operation. CO is the main pollutant emitted by heavy-duty diesel trucks that has a short-term ambient air quality standard. Since CO emissions from diesel-powered equipment is relatively low, and since pollutants will rapidly disperse downwind from the facilities, no impacts are expected at the nearest residential areas.

20.2.5 Noise And Vibration

This section summarizes the noise and vibration effects expected during the construction phase of the project. It presents the noise and vibration criteria, describes the sources (such as equipment and traffic), and presents an analysis of impacts from these sources.

20.2.5(a) Construction Noise

The construction noise impact assessment is based on a comparison of the predicted construction noise levels with existing (i.e., ambient) noise levels in the project area. Construction of the Artery/Tunnel Project will take place in overlapping stages with construction-related noise impacts in different areas. The construction noise levels will vary depending on the type of activity underway and the time of construction.

Noise Criteria. Federal Highway Administration specific guidelines to assess construction noise impacts require the following: ". . . determine the measures which are

Table 20.9

GASEOUS EMISSION RATES FOR CONCRETE BATCH PLANT
(Tons Per Year)

	Estimated Batch Plant Emissions	EPA Significance Level
Particulate Matter	0.22	15
Sulfur Dioxide	3.10	40
Carbon Monoxide	0.54	100
Nitrogen Oxides	2.18	40
Volatile Organic Compounds	0.04	40

Source: Bechtel/Parsons Brinckerhoff, December 1988 needed in the contract plans and specifications to minimize or eliminate adverse construction noise impacts to the community." Accordingly, for purposes of assessing construction noise impacts for this SEIS/R, noise criteria, which compare the change in existing noise levels in the community during construction, have been used.

A project design criterion of a maximum construction noise level of 85 dBA at 50 feet or at the nearest noise sensitive receptor has been selected. This criterion is consistent with the City of Boston Noise Ordinance. In addition to specifying a maximum noise level of 86 dBA at a distance of 50 feet from a construction device, the City of Boston noise ordinance requires that construction noise shall not exceed 50 dBA at the lot line of a residential lot, between the hours of 6 PM and 7 AM. In the Central and I-93/I-90 Interchange areas, second and third shift work will be performed during peak construction periods. In other areas, some temporary construction activity will take place during nighttime hours. Under these circumstances, application will be made to the Air Pollution Control Commission of the City of Boston to grant a variance under regulation 7 of the City of Boston regulations for the control of noise (City of Boston Code, Ordinances, Title 7, Section 50).

Construction Noise Sources. On-site noise sources during construction will include such equipment as backhoes, clamshell bucket excavators, vibratory pile extractors, earth compactors, cranes, tractor-mounted breakers, sheet pile drivers, pumps, generators, compressors, and miscellaneous support equipment. Other noise sources will be those associated with construction-generated traffic. (Typical noise levels generated by construction equipment are presented in Table 20.10.)

A noise prediction model has been developed to assess impacts from construction activities. This model utilizes the information generated by the project's construction engineers on detailed methods and types of equipment which would be used on each section of the Proposed Action. (A full description of the model and input assumptions is found in the Noise and Vibration Appendix.)

The assessment of noise impacts considers the different construction activities and equipment that will be used at each site. Some of the typical activities will include utility relocation, construction of ventilation buildings and barge loading facilities, slurry wall/cofferdam construction, Central Artery underpinning, and demolition of existing buildings and piers.

Construction Noise Impacts And Assessment. Twelve noise-sensitive locations were selected initially to assess the noise impacts during construction. These locations are representative of diverse land uses within close proximity to the construction activities and sites (see Figure 20.30). The locations selected include such varied land uses as residential and institutional buildings, parks, historic buildings, and other properties.

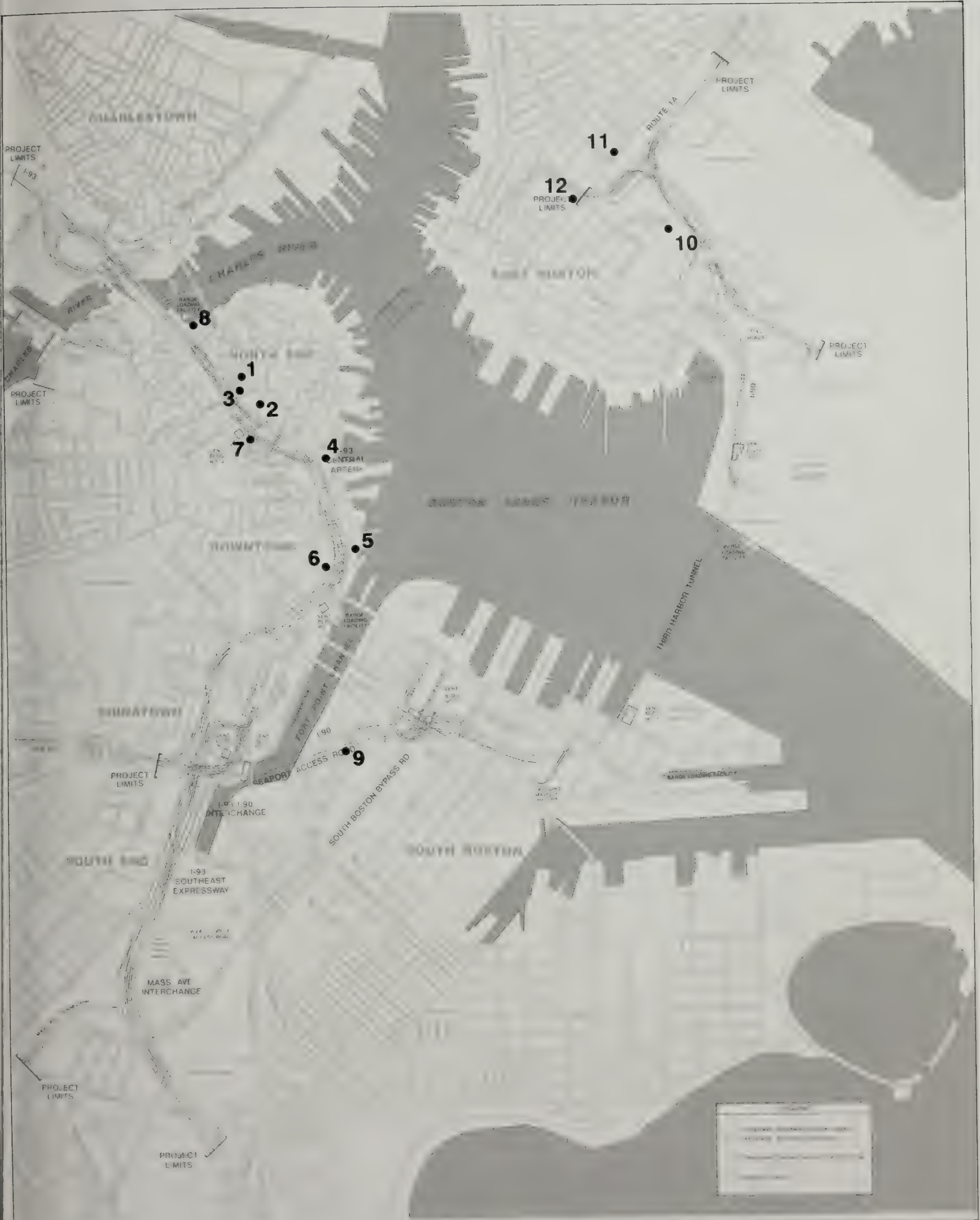
Table 20.11 summarizes the maximum predicted noise levels within 200 feet of the construction site boundary at each of the 12 receptors during the construction phase. The construction noise level estimated at each receptor was compared to the existing background noise level, and its impact was assessed. During some construction activities, moderate to substantial noise impacts will occur for short durations at some areas north of Causeway Street and in the Central Area, at the Artists Colony in the South Boston area, at the

Table 20.10

TYPICAL NOISE LEVELS FROM CONSTRUCTION EQUIPMENT

Equipment	A-weighted Sound Level (dBA) at 100 feet
Earthmoving	
front loader	80
backhoe	80
bulldozers	82
tractors	75
scrapers	82
graders	80
truck	80
paver	82
Materials Handling	
concrete mixer	80
concrete pump	76
crane	80
derrick	80
Stationary	
pumps	70
generators	70
compressors	75
Impact	
pile drivers	90 - 95
jack hammers	80 - 82
rock drills	90
pneumatic tools	80
Other	
saws	70
vibrators	70

Source: Report of the Predesign Studies of Noise and Ground Vibration for NW LRT, City of Calgary, October 1986



FIGURE

20.30

Representative Sites For Construction Noise Impact Assessment

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT

SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

Memorial Stadium in East Boston, and at residential areas in East Boston. Such impacts will occur for longer durations at Sites 3, 4, 7, and 8.

Minor to moderate impacts are expected at certain locations in the Central Area, in South Boston, and in East Boston. The period of the impact will range from 1 to 55 weeks, depending on the site and construction stage, during working hours. Minor impacts are expected at all locations during certain stages of construction. The maximum duration of minor impact will be close to 81 weeks.

Using information provided by planning phase estimates and supportive engineering reports, projection of the duration of construction noise at the different receptors were made (see Table 20.11). (A full description of the duration of construction activities is contained in the Noise and Vibration Appendix.)

Other locations with similar land uses and at similar distances from the construction activity will receive noise impacts of the same magnitude as those detailed above. Since the sites under discussion here were analyzed only because they were considered to be representative of noise-sensitive receptors, other structures and buildings along the alignment that will be similarly impacted by noise from construction activities will be identified and mitigation measures developed. The identification of buildings and structures involved and the identification of appropriate mitigation measures will be undertaken during design development and included in specification documents for section design contracts.

20.2.5(b) Vibration Levels

Assessment of potential vibration effects from construction of the Proposed Action is accomplished by estimating the absolute vibration levels at sensitive sites, including historic buildings, and by comparing the potential vibrations due to project activities with the acceptability and damage risk criteria for ground vibrations. The specific concerns to the project are potential damage to sensitive historic buildings, likely effects on occupant comfort within buildings, and the operation of sensitive commercial and industrial equipment.

20.2.5(c) Vibration Criteria

There are no regulatory requirements established for the assessment of groundborne vibration from construction activities. The following vibration standards have been selected as the project design criteria to gauge the likelihood of cosmetic, minor or structural damage to buildings, and annoyance to people.

A widely accepted criterion for minor or cosmetic damage (such as plaster cracking or reopening or rewidening of preexisting cracks) is 0.2 inch per second peak velocity for nonhistoric residential and office buildings. This level is far below the threshold of risk of major structural damage, but it makes allowance for buildings of all types and for the possible triggering effect of vibration on stress concentrations that may already be present in an affected building.

The above described criterion of 0.2 in/sec is also applicable to old and historic buildings. However, in view of the uncertainty of the condition of historic structures, and to provide an additional measure of safety, a peak ground vibration velocity of 0.12 in/sec has been selected as the project design criterion.

Table 20.11

MAXIMUM PREDICTED CONSTRUCTION NOISE LEVELS - L_{eq} (dBA)

Site	Existing Location	Existing Level	Noise	Type of Activity	Duration Of Moderate to Substantial Impact[1]
1	Casa Maria Housing	66	77-82	Slurry Wall	1
2	Residences at Salem and Cross Streets	68	79-84	Slurry Wall	36
3	Residences at Stillman Place	68	85-100	Slurry Wall	84 (Substantial)
4	Waterfront Park	68	83-88	Slurry Wall	54
5	Harbor Towers	71	79-84	Slurry Wall	0
6	International Place	72	85-90	Slurry Wall	14
7	Apartments in Marshall Street	68	82-87	Construction Vent. Bldg.	62
8	Waterfront Picnic Area North of Causeway St.	69	85-92	Remove existing structure	44
9	Artists' Colony	72	93-104	Support Existing Bldg.	20 (Substantial)
10	Memorial Stadium East Boston	67	83-88	Construct Surface Roadway	5
11	Bremen St. (Residence near Prescott St.)	68	68-74	Construct Surface Roadway	0
12	Bremen St. (Residences at Porter St.)	71	85-90	Viaduct Construction	9

---

1. The duration of impact is the estimated total number of weeks, throughout the construction period, that the construction noise will occur based on a typical construction schedule and sequence

Source: Bechtel/Parsons Brinckerhoff

The Commonwealth of Massachusetts ground vibration criterion of 1.9 in/sec peak velocity for blasting has been selected as an appropriate criterion to assess the likelihood of structural damage from construction-induced vibration.

Annoyance indicators are based on the guidelines developed by the International Standards Organization (ISO) and the American National Standards Institute (ANSI). A constant peak velocity in the 8 hertz (Hz) to 80 Hz range has been selected for different activities or land uses (see Table 20.12). The criterion for critical areas is 0.005 in/sec, and for residences at night -- 0.007 in/sec.

Construction Vibration. The operation of construction equipment results in vibration of the ground, which propagates through the ground and can cause nearby structures to vibrate. Vibration effects tend to be more localized than noise effects and are, therefore, experienced within buildings and by their occupants. The general approach used to predict such vibration effects consists of the following steps:

- determination of the ground vibration amplitudes generated by the source
- estimation of the attenuation of ground vibration amplitude with distance
- estimation of the vibration coupling between the ground and nearby structures

The prime focus of the SEIS/R is on potential structural or cosmetic damage to structures within approximately 110 feet of a vibration source, the distance at which minor cosmetic damage to historic buildings may result from pile driving operations. This is a worst-case analysis, and it predicts unmitigated vibration impacts, which will be mitigated as required.

During construction of the Proposed Action, sources of vibration will include pile driving, for limited purposes, slurry wall construction, and demolition of existing ramps and viaducts. Other construction activities, such as pavement breaking and earth compaction, will also generate high levels of vibration, but these are not expected to be dominant sources of vibration at sensitive locations in the project construction area.

During subaqueous blasting, which will take place during the Third Harbor Tunnel construction, vibration levels generated will have no effect at locations of 200 feet or more from the blasting site. There are no residences, occupied buildings, or sensitive structures within 200 feet of the tunnel alignment. Therefore, blasting induced vibrations are of no concern in the area of the tunnel alignment.

The project alignment along Atlantic Avenue will also require blasting for deep tunnel construction. The strength of the blasting charges used will be limited to a maximum groundborne vibration of 1.9 in/sec at or within any structure in the vicinity of the blasting site. Blasting could also be employed to remove unanticipated rock or structures at other locations using the same approach.

Nonconstruction Traffic Vibration. Traffic diversion and detouring will not adversely impact structures along the traffic routes. Movement of heavy duty delivery trucks very close to residences would have the potential to generate annoying conditions of vibration inside the residences during individual vehicle passby. The intensity, however, will be far below the level that might produce minor damage to buildings, such as cracks in paintwork or plaster.

Table 20.12

CRITERIA FOR ANNOYANCE DUE TO GROUNDBORNE VIBRATION IN BUILDINGS

Building Use Category	Upper Limit of Peak Vibration Velocity (in./sec.)	Comments
Hospital and Critical Areas	0.005	
Residential (nighttime)	0.007	
Residential (daytime)	0.010	Criterion also applies to churches, schools, hotels, and theaters
Office	0.020	Criterion applies to commercial establishments
Factory	0.030	Criterion applies to industrial establishments

Source: Artery/Tunnel Project FEIS/R (1985)

Construction Equipment Vibration Levels. During construction of the Proposed Action, the sources of vibration will depend on the type of construction activity and equipment used at any given site. (Construction vibration sources and the vibration velocity of these sources are presented in Table 20.13.) At sites where demolition will occur, tractor-mounted pavement breakers and at-grade earth compactors will be used. Where a viaduct is constructed, pile driving will be the major vibration-producing activity. Sheet piling, which generates relatively low vibration levels, is proposed for ramp construction. Most of the widened and depressed Central Artery will involve slurry wall construction, and the equipment used will be clam bucket excavators and slurry and concrete pumps.

Peak vibration velocities generated by the operation of conventional pile driving equipment will drop off to 0.2 in/sec at a distance of 100 feet. Vibration velocity levels will be considerably lower than this for drilled and sheet piles and for piles driven into silt and clay soils, such as are found in much of the Boston area. Vibration velocities generated during excavation and trenching for slurry wall construction will typically lie in the range of 0.1 to 0.3 in/sec at distances of up to 10 feet from excavation. Worst-case, single-event occurrences of clam shovel drop, clam shovel bump, and chisel drop will generate peak vibration velocities in the range of 0.09 to 0.14 in/sec at a distance of approximately 50 feet. These levels are predicted from existing vibration data supplemented by analytical methods (see Noise and Vibration Appendix). Historic structures which are located within a distance of approximately 12 feet from slurry wall construction will be inventoried and receive a structural integrity inspection and monitoring during construction.

Construction Vibration Impacts. Vibration impacts are difficult to predict. In granular soils, which are loose or in medium-dense condition, the possibility exists that the soil may compact due to vibration during certain types of construction activities such as slurry wall construction, pile driving, compaction, and demolition. Vibration and compaction caused by these activities can cause buildings or structures to settle. In cohesive soils, vibrations have much less effect during construction. However, if water is allowed to escape or the soil dries out (as in dewatering), consolidation may occur. Structures that are sensitive to vibration will have additional borings drilled near them in order to evaluate the potential impact of the proposed construction.

A comparison of predicted vibration with the design criteria selected for historic and nonhistoric structures will define a set of distances from the construction activity within which damage or annoyance could be expected to occur for various types of structures. Damage will not occur, even to sensitive structures, located at a distance of approximately 12 feet or greater (except for pile driving operations).

Construction vibration impacts on the existing subway and other tunnels will be less than the existing vibration levels inside tunnels during the passing of subway trains.

Slurry wall construction will be performed near historic buildings to fully offset the potential for structural damage within a foot, and cosmetic damage (plaster cracking and 1 preexisting cracks widening) within 12 feet, of construction. For nonhistoric buildings these distances are 1 foot and 8 feet, respectively. Since there are no buildings within 1 foot of slurry wall construction, structural damage to any building near the Proposed Action is very unlikely with slurry wall construction. The approximate number of buildings

Table 20.13

TYPICAL VIBRATION LEVELS DUE TO CONSTRUCTION EQUIPMENT AND TRAFFIC AT 100-FOOT DISTANCE[1]

Source	Maximum Particle Velocity[2] (in/sec)
Diesel Pile Driver (36,000 ft/lb or 49,000 joules)	0.2
Vibratory Pile Driver	0.15
Vibratory Compactor	0.03
Pavement Breaker	0.05
Large Bulldozer	0.011
Heavy Trucks	0.01
Jack Hammers	0.003
LRT Passby (maximum level)	0.002
Vibration Criteria (old house, poor conditions)	
after CHAE (ASCE 48, pp 77-79, 1978)	0.5
Swiss Standard, Blasting	0.3
Swiss Standard for Machines and Traffic	0.12-0.2

---

1. For other distances d, the expected level may be determined by the formula:

$$V(d) = \frac{V(100)}{\frac{d}{100}}$$

where V(d), and V(100) are the particle velocities at d feet and 100 feet, respectively

2. Maximum particle velocity is used in determining impact distances and in the assessment of structural damage

Source: Report on the Predesign Studies of Noise and Ground Vibration for NW LRT, City of Calgary, October, 1986 that will require monitoring and special attention during slurry wall construction is six in the Central Area, seven in Chinatown, and one in South Boston, without which cosmetic damage could possibly occur. The potentially affected buildings are identified below:

- Central Area
    - 6 Stillman Place
    - Purity Cheese (Endicott and Cross Streets)
    - Parking garage (Miller Street and Atlantic Avenue)
    - 518-540 Atlantic Avenue (Russia Wharf)
    - South Station
    - 171-189 State Street

- Chinatown
    - 687-695 Atlantic Avenue
    - 204-216 South Street
    - 766 Atlantic Avenue
    - 66-86 Lincoln Street
    - Boston Button & Display (2-32 Albany Street)
    - 6-18 Hudson Street
    - Wang building

- South Boston
    - 249 A Street

Slurry walls will be constructed along most of the Central Artery alignment and other areas of the project where tunnels are constructed. Pile foundations will be required for ramps and viaduct structures in areas such as I-93/I-90 Interchange, Route 1A interchange, South Boston, and in the Area North of Causeway Street.

Pile driving operations will require mitigation measures when they occur within approximately 110 feet of historic buildings, and within approximately 60 feet of nonhistoric buildings and subway tunnels to prevent minor or cosmetic damage. Special efforts will be made to protect buildings within 5 to 6 feet from suffering any structural damage. Mitigation will consist of auger driven piles instead of impact driven piles.

The structures that will be affected by pile driving for ramp and viaduct construction are identified in Tables 20.14 and 20.15 as historic and nonhistoric buildings, respectively. The inventory of historic buildings in the Project Conservator's draft report of December 1988 was used to identify these buildings that are within 110 feet of pile driving. Project 100-scale maps were used to identify nonhistoric buildings within 60 feet of pile driving activity.

20.2.6 Water Resources, Ecology And Wetlands

This section summarizes the short-term impacts to water resources during the construction phase of the project. Where appropriate, ecological and wetlands impacts are also discussed.

20.2.6(a) Boston Inner Harbor

Actions taking place in Boston Inner Harbor during construction that can have water resource, ecology, and wetlands impacts have been identified as the following:

- o Underwater blasting and dredging
- o Tunnel placement and backfilling
- o Filling
- o Barge loading terminal operations
- o Coastal wetland resource areas

Underwater Blasting. The Third Harbor Tunnel construction will require the underwater removal of approximately 201,000 cubic yards of rock. Underwater blasting has been proposed to loosen much of the rock for removal, using charges designed specifically for this purpose. Blasting will occur at depths of approximately 50 feet below the water surface in the area near South Boston (Subaru Pier) and at approximately 80 to 90 feet further out in the Harbor (about 3,300 feet into the Harbor). The rock generally lies about 40 feet below the project datum in the Harbor and, to allow for the tunnel structure and required overdraught, approximately 40 to 50 feet of rock will have to be removed in the center of the channel and considerably less near East Boston.

The necessary blasting represents a potential source of adverse environmental effects, including destruction of fish and other organisms. The severity of the impact to biota resulting from any underwater blasting program is a function of several parameters. These include: the type and quantity of material to be removed; its depth below the water surface and positioning in relation to the shoreline; bottom configuration; the amount of explosives used; and the type and abundance of organisms in the area.

Since blasting may kill fish in the path of the resulting shockwaves, procedures which would reduce the potential adverse impact on Harbor life are being investigated. A blasting mitigation plan, using the best available technology and control strategy, will be developed during final design.

Dredging. Construction of the tunnel under Boston Harbor from South Boston to Logan Airport will be by the immersed tube method. Clamshell dredging of the necessary trench is anticipated, and will require removal of approximately 1,065,000 cubic yards of material.

Since clamshell dredging will release a vertical line source of sediment, a model for the prediction of consequences associated with dredging for the Artery/Tunnel Project is appropriate. A dispersion model developed by the Marine Sciences Research Center (MSRC) for the Army Corps of Engineers was applied to the dredging activities in Boston Harbor using information specific to the construction site. This model, documented in Field Investigations of the Nature, Degree, and Extent of Turbidity Generated by Open-Water Pipeline Disposal Operations (Schubel *et al.*, 1978), presents a solution of the general equation of motion for suspended sediment in a steady and spatially uniform flow field with a single uniform vertical line source of sediment.

The potential impacts to water quality from the dredging include the following: sediments are suspended in the water column; there is a turbidity plume; and that other sediment parameters may be released to the water column at low concentrations. The rate of dredging

Table 20.14

HISTORIC BUILDINGS AND STRUCTURES WITHIN 110 FEET OF PILE DRIVING ACTIVITIES

ID#[1]	Name	Address	Approx.[2] Dist.
124	Hoffman Building	160 N. Washington Street	30
112	Stop & Shop Bakery	214-246 Causeway Street	30
12	Braman Dow Co.	239-245 Causeway Street	40
26	Powers Candy Co.	6-10 Medford Street	30
106	--	2,3,4,5,6 Stillman Place	0
83	Mother Anna's	213 Hanover Street	30
94	Boston Police Academy	140-178 North Street	10
61	--	70-110 Commercial Street	
64	Mercantile Wharf	73-117 Commercial Street	30
143	Broadway Bridge	Near I-93/I-90 Interchange	65
370	--	363 Albany Street	10-15
371	--	365 Albany Street	60
402	--	2-66 Thayer Street	60
	Registry of Motor Vehicles	100 Nashua Street	30

---

1. Identification numbers are taken from the Project Conservator's Preliminary Study Report, December 1988
2. In feet

Source: Bechtel/Parsons Brinckerhoff

Table 20.15

NONHISTORIC BUILDINGS WITHIN 60 FEET OF PILE DRIVING ACTIVITIES

Name	Approximate Address	Distance (feet)
--	162 Bremen Street	60
--	118 Porter Street	60
--	135 Chelsea Street	60
MDC Detention Chlorination Pumping Station	Charlestown	55
Northern Terminals	Charlestown	20
Eastern Airlines Reservation Center	Logan Airport	10
Pan Am Air Freight	Logan Airport	20
Hilton Hotel	Logan Airport	10
--	Corner Cooper Street/Stillman Place	60
--	Stillman Place Endicott Street	40-60
City of Boston Central Maintenance Facility	South End	50
--	214-217 Albany Street	60
Boston Thermal	Nashua Street	20
Jail Site	Nashua Street	30
Northcoast Seafood	South Boston	30-50
Parking Garage	Clinton/North Street	0
--	47-51 Fulton Street	40
Wang Building	Kneeland Street	20-30

Source: Bechtel/Parsons Brinckerhoff

for this project will be at a maximum of 10,000 cubic yards daily. Using the MSRC model, the extent of the suspended sediment plume was computed and is illustrated in Figure 20.31 (see the Construction Appendix). In the model, the plume is defined as the area with a suspended solids concentration 5 mg/l above the background levels. As reported in Chapter 13, background suspended solids average 11 mg/l with a range of 0.0 - 26 mg/l. Using the 5 mg/l isopleth as the boundary of the plume (see Figure 20.31), the average width of the plume will be approximately 110 meters and will have an average length of 1,200 meters. Outside a 100-meter band nearest the dredge, suspended solids concentrations will decrease to normal ranges for the Inner Harbor. Closer to the dredge, however, suspended solids may reach 600 mg/l. The maximum concentration near the bottom of the water column will be somewhat higher and may range from approximately twice the concentration shown in the figure near the dredge, to approximately four times the average concentration at the end of the plume.

In its Order of Conditions to Massport for the South Boston Naval Annex filling, DEP (July 16, 1980; File No. 6-148) defined a turbidity plume as: ". . . the area in which the effects of solids, suspended in the water column are present in concentrations in excess of 50 mg/l over background values." With this definition as a guideline, the length of a turbidity plume from the I-90 Tunnel dredging can be estimated to be significantly less than those described previously. Under these conditions, the 50 mg/l concentration will occur at approximately 300 meters.

The most recent studies, using the MIT models for circulation and transport in the Harbor, indicate that the turbidity plume for the low resuspension rate typical of a suction dredge, will have even less impact than that calculated using the MSRC model. Using a higher source rate typical of a bucket dredge, the turbidity plume is less than 200 meters in extent.

Elutriate Analysis. The elutriative (ability to be released) qualities of sediments along the I-90 tunnel alignment were examined during the preparation of the FEIS/R. Eight elutriate analyses were conducted to determine the degree to which metals would be released from the sediment matrix. The analyses indicated that the greatest and most consistent release would take place from surface sediments. The metals most consistently released included arsenic, cadmium, lead, and zinc.

Elutriate analyses are a very conservative estimate of the potential release of a number of sediment-borne contaminants during dredging (particularly hydraulic dredging). In the test process water and sediment are mixed and agitated in an aerobic environment at a ratio of 4:1 for 30 minutes; they are filtered, and the elutriate is analyzed. During clamshell dredging operations, however, this type of process does not take place as most of the sediment (79 percent) is confined within the dredge bucket. Notwithstanding the results of these elutriate analyses, a more conservative estimate of the amount of contaminants in suspension with the sediments was made by assuming that all of the contaminants will remain with the suspended sediments at the bulk concentrations found in the surface sediments. The analyses that have been reported in the FEIS/R indicate the sediment-associated metals in the dredge plume will for the most part be in the parts-per-billion range. Lead and zinc could be present at the highest concentrations 20 meters from the dredge. At the end of the plume, the concentrations would be less than 1 part per billion.

Marine Resources. During dredging operations there will be a total loss of benthic macrofauna closest to the dredge. Benthic organisms further away (200 meters) but still within the plume will, for the most part, be able to migrate through the thin accumulations of sediment. Feeding of the dominant species, which are pollution tolerant, will not be interrupted in the further reaches of the plume. The impacts to benthic organisms during construction will, however, be short-term. After dredging and construction are completed, recolonization will commence the following spring and will be complete within several years. The habitat on top of the tunnel will be able to support more diversity in the future than the bottom does at present due to the voids in the protective rock mat that will be placed on top of the tunnel.

Crustaceans and fish are more mobile than are other species of the benthic community. They are, therefore, more capable of avoiding an undesirable area, such as what will exist close to the dredge. Short-term impacts to the crustaceans and finfish are expected to be limited mortality and avoidance of the construction site.

There is an annual migration of such anadromous fish through Boston Harbor as alewife, smelt, and menhaden. Although not an anadromous fish, per se, winter flounder enter the Harbor in late winter and early spring to spawn. In order to protect these important fish, the Division of Marine Fisheries has adopted an annual prohibition on dredging and filling activities during the period of March 15 to June 15 unless sufficient cause is shown to allow such activities during the period. These guidelines will be respected.

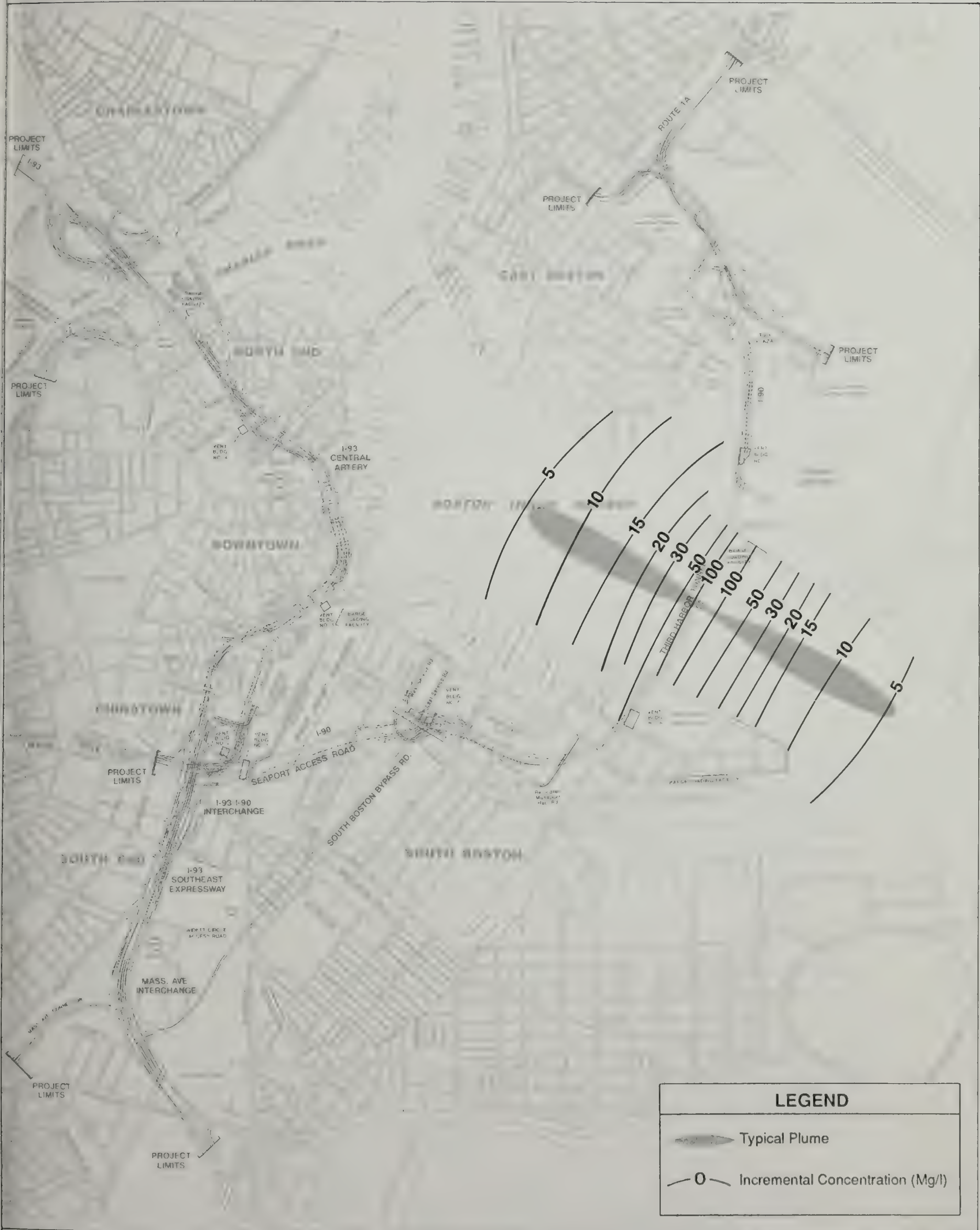
While dredging for the Harbor crossing would most likely result in the general avoidance of the area by smelt and alewives, it could cause an interruption in the spawning cycle. Dredging during the winter flounder spawning period could result in the smothering of developing eggs as well.

There are no soft-shell clams in the project area which could be affected by dredging and blasting, because of the lack of suitable habitat at these sites. Blue mussels that may have colonized the riprap along the bulkheads in South Boston and Logan Airport will suffer mortality, if they are sufficiently close to sources of suspended solids. They will, however, recolonize within several years after construction is completed. None of the blue mussels in the project area are available for harvesting, due to existing pollution levels.

Marine mammals known periodically to inhabit the Harbor include harbor seals, harbor porpoises, and grampus. These animals are capable of avoiding an area of high turbidity, such as that near the dredge as well as areas close to detonations.

Lobster fishing along both dikes on either side of the Harbor, at the site of the Third Harbor Tunnel alignment will be interrupted during construction. This impact will be negligible, as lobstering at these locations is minimal compared to other locations in the Harbor.

Tunnel Placement And Backfilling. Prior to the placement of tunnel sections, the bottom of the dredged trench must be leveled, and a gravel foundation mat must be created. This process, known as screeding, takes place under controlled conditions from a screed barge, and turbidity impacts are minimal. Similarly, impacts from placement of the gravel foundation mat will be minimal as the work will also take place under controlled conditions using select gravel which contains a minimum of fines, i.e., the material will sink rapidly to the bottom.



FIGURE

20.31 **Suspended Sediments**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

0 800 1600 2400 3200 Feet

There will be little or no impact from the placement of tunnel sections. Backfilling will take place under highly controlled conditions with fill being specifically placed where needed through such methods as the tremie technique, placement with clamshell dredge buckets, or others.

Filling. Approximately 3,200 square feet of water (5,330 cubic yards) will be filled with concrete structure in the area between the Subaru Terminal and the General Ship dry dock. Construction will take place behind sheet steel walls and will not result in water quality impacts.

Barge Loading Terminals. Two barge loading terminals will be constructed and operated during the construction process in Boston Inner Harbor. Their purpose will be to provide for the loading of excavated material onto barges for transportation to Spectacle Island for disposal. Neither barge loading terminal will require dredging. Support piles for the Bird Island Flats terminal will be driven into the sediment resulting in no impact to water quality. The barge loading terminal at Dry Dock #3 will require no water-based construction as all structures will be erected on land.

Coastal Wetland Resource Areas. The resource functions that Boston Inner Harbor perform are:

- flood control capacity
- storm damage prevention
- fisheries habitat
- wildlife habitat
- designated port area
- navigation

There will be disturbance to the existing riprap bank at the Bird Island Flats end of the tunnel. The riprap will be replaced and recolonization by the benthic community will follow after the completion of construction when the environment stabilizes. The existing steel sheet pile wall at the C Street bulkhead at the South Boston end will also be disturbed. The riprap bank will be replaced with a bank of 3,145 square feet of structural fill faced with large rock (i.e., riprap). All the replaced or new surfaces will colonize following construction.

The actions taking place during construction in Boston Inner Harbor will mostly affect fisheries and wildlife habitats, as indicated in the above discussions. The extent of these habitats are dependent in part on the water quality and turbidity which are also described above.

The resource area's ability to function as flood control and storm damage prevention is not substantially impacted as a result of construction activities since an insignificant volume of water body will be displaced. (Impacts on navigation during construction are discussed in Section 20.2.1 on transportation.)

20.2.6(b) Fort Point Channel

Actions taking place in Fort Point Channel during construction that can have water resource, ecology, and wetlands impacts have been identified as the following:

- Seaport Access Road tunnel dredging
- Tunnel construction facilities
- Filling
- Barge loading terminal operations
- Seawater users
- Bridges
- Coastal wetland resource areas

Seaport Access Road Tunnel Dredging. Approximately 240,000 cubic yards of sediment will be removed from the Fort Point Channel/South Bay area. Construction upstream of Dorchester Avenue will take place in the dry, while tidal flow into and from the Roxbury Canal Conduit continues. Approximately 24,000 cubic yards of sediment will be removed in this manner from behind circular cofferdams and steel sheet pile walls.

The need to maintain drainage from the Roxbury Canal Conduit upstream of the construction area, and the shallowness of the Red Line tunnel under the construction site, rule out the possibility of all of the construction taking place in the dry behind cofferdams. From approximately 100 feet downstream of the Dorchester Avenue bridge, across the Channel to the Gillette shoreline, dredging will have to take place in the wet. Approximately 216,000 cubic yards of sediment will be removed in this manner.

Piers to support the tunnel over the Red Line tunnel will first be dredged in the wet, and then construction will take place within steel sheet pile walls.

In addition to turbidity and suspended solids, there will also be other water quality impacts associated with releases of metals, oil and grease, petroleum fractions, and nutrients. Elutriate analyses, which are conservative estimates of such water quality impacts, were conducted on sediments from Fort Point Channel. (The results of these analyses were reported in Appendix 7 of the Draft Environmental Impact Statement/Report for the Third Harbor Tunnel Project, published in December 1982.) These results indicated releases of such contaminants as arsenic, cadmium, copper, lead, mercury, nickel, vanadium, zinc, nitrogen, phosphorus, and oil and grease. Such findings are consistent with results of the bulk sediment analyses which have indicated that sediments are contaminated by these substances. There were no releases of PCBs, as few were present.

In terms of magnitude, the highest release of metals was 2.5 times above background concentrations in the receiving water (most release for metals were less than two times the background concentrations). Using the 2.5 factor as a maximum upper limit, it would take a water to sediment ratio of less than 10 in order to exceed background water quality. As there is more water volume in this area than there is contaminated sediment to be dredged, the impacts to water quality from metals will be smaller than the elutriate analyses indicate. Nonetheless, measures to mitigate these conditions are described below.

Tunnel Construction Facilities. Tunnel structures crossing Fort Point Channel from the vicinity of Dorchester Avenue to the Gillette Company side will be constructed and placed using immersed tube methods. Under this method, the tunnel sections will be precast in a casting basin constructed within the alignment on the east approach of the Channel, floated into place, sunk, and attached to supporting piers.

Excavation of the Fort Point Channel casting basin and casting of the structures will take place in the dry behind a cellular cofferdam, steel sheeting or a reinforced concrete slurry wall. The tube elements will have to be constructed in the casting basin. The casting basin has been designed so that its construction sequence and use will have minimal impacts on water quality, as follows:

- o Sheet steel is driven for each cell of the cofferdam.
- o Muck and loose sediments are dredged from within each cell.
- o Each cell is filled with granular materials (sand/gravel) that will evenly consolidate to provide strength to the cells.
- o Once final closure is made, the remaining water between the cofferdam and land is pumped out into the Fort Point Channel behind a silt curtain barrier. At this point there should be little turbidity in the water.
- o Construction of the casting basin retaining walls will proceed during cofferdam construction.
- o Excavation of the casting basin takes place in the dry. All rain and seepage water pumped from within the basin will be disposed of behind a silt curtain barrier to control dispersion of turbidity in the Fort Point Channel.
- o Once the tunnel sections are completed, the basin is cleaned of timber and other debris, partially flooded by pumping water into it from the Fort Point Channel and the tunnel sections are floated.
- o After near equal water pressure (allowing for tidal variations) is attached on the cofferdam, the sand/gravel fill within the cells is removed, sheet steel extracted, and the basin is open to the Fort Point Channel. Given the length of time it will take to remove the cofferdam after flooding, any solids that were suspended from the flooding will have settled. The tunnel sections will be slowly moved out of the basin for placement.
- o The cofferdam will be reestablished to allow the completion of the cut and cover section and joining of the immersed tube sections.

Using these construction techniques, impacts to water quality will be negligible.

Filling. Between the 1985 FEIS/R and the present design, a number of changes have been made that have resulted in major reductions in the amount of filling. Under the Proposed Action, there has been an elimination of total filling of the South Bay (i.e., Upper Fort Point Channel) area, and the northbound Central Artery has been moved out of Fort Point Channel to Atlantic Avenue. These changes have resulted in a 60 percent reduction in the area filled, and a 66 percent reduction in the volume of fill. Rather, any loss of marine resource areas will be attributable to ramp and tunnel structures.

Temporary filling during construction will take place along the Dorchester Avenue and Gillette sides of the Channel. These structures, generally cofferdams, will be removed at the completion of construction. It is anticipated that the reduced flow area due to the construction of the cofferdams around Dorchester Avenue Bridge will result in increased flow velocities. A hydraulic analysis using the HEC-2 model was conducted. The results indicate that the flow velocity will increase to 15 fps during a 100 year flood. New soundings for the exact depth of the channel in the South Bay area are being conducted.

Barge Loading Terminal Operations. One barge loading terminal will be constructed and operated during the construction process in Fort Point Channel. The purpose is to provide for the loading of excavated materials onto barges for transportation to Spectacle Island for disposal. The barge loading terminal on Fort Point Channel will be constructed at the Boston Edison substation on the west side of the Channel along Atlantic Avenue. Dredging will not be required. Support structures for the terminal will be driven into the sediment resulting in no impact to water quality.

Seawater Users. There are three users of seawater on Fort Point Channel that will be affected during construction. They are the Gillette Company, James Hook and Company, and Neptune Lobster Company. Construction-related impacts to these companies are addressed in Section 20.2.6(e) under projectwide issues.

Bridges. A number of bridges crossing Upper Fort Point Channel will have to be replaced and rebuilt. As they are being replaced, temporary bridges will have to be provided. These bridges include:

- Dorchester Avenue bridge
- Old Colony Line 7 Railroad bridge
- Wye Connector
- Broadway bridge (partially rebuilt)

Supporting structures will be constructed using pile driving techniques and sheet steel cofferdams, and impacts to water quality will be minimal. In all instances, water flow to and from the Roxbury Canal Conduit will continue.

Coastal Wetland Resource Areas. The resource functions that Fort Point Channel performs are:

- flood control capacity
- storm damage control
- fisheries habitat
- wildlife habitat
- recreational navigation

Approximately 2,500 linear feet of coastal banks, which consist of the existing granite block seawalls, will be disturbed during construction. These banks will be replaced by a combination of granite block surfacing, concrete, and riprap. Casting of the Seaport Access Road tunnel structure will require the construction of a casting basin. Circular cofferdams will form a west wall to contain the structure. The casting basin will be filled back to the original shoreline and a new seawall will be reinstated. This temporary structure will not prevent the resource area from performing its functions of flood control or prevention of storm damage since it does not affect the capacity of the Channel.

Placement of the tunnel will cause water quality and turbidity impacts as discussed above. The cofferdams which will be placed along the Channel will narrow its width, causing increased flow velocity.

There is no designated fish run in Fort Point Channel.

[Short-term impacts to navigation in Fort Point Channel are discussed in Section 20.2.1(e).]

20.2.6(c) Charles River

Actions taking place in the Charles River during construction that are likely to have water resource, ecology, and wetlands impacts have been identified as the following:

- o Charles River bridge crossing
- o Filling
- o Barge loading terminal operations
- o Inland wetland resource area work

Charles River Bridge Crossing. The bridges crossing the Charles River will require approximately 2,500 square feet of supporting piers. Each pier will be constructed within sheet steel pile cofferdams. Therefore, removal of sediments will result in minimal water quality impacts. Once the bulk of material has been removed, the cofferdam area will be dewatered. Dewatering will result in minimal water quality impacts, and those will be due primarily to turbid water. Because all of the contaminated sediments will have been removed, impacts from PCBs and metals will not be present.

Filling. The new bridge piers will result in the displacement of approximately 0.12 acre of water by structure. In the 1985 FEIS/R, construction would have resulted in the permanent loss of 1.37 acre of water surface area. This is an 91.2 percent reduction of filling.

Barge Loading Terminal Operations. A barge loading terminal will be constructed in the Lower Charles River below the Charles River dam. As was the case with the other barge loading terminals, dredging will not be required and all in-water structures will be pile supported. The barge terminal facilities will be removed following completion of construction.

Inland Wetland Resource Areas. The resource functions that the Lower Charles River Basin and Millers River perform are:

- o flood control capacity
- o storm damage control
- o prevention of pollution
- o bordering vegetated wetlands
- o fisheries habitat
- o wildlife habitat
- o navigation

During construction there may be a temporary disturbance to the banks of the Lower Charles River. While this is unavoidable, the banks will be restored as soon as possible after construction.

Construction of the new bridge piers will also cause disturbance of the river bottom, resulting primarily in turbidity and sedimentation impacts, as described above. Fisheries may be affected by these impacts. Following construction, these sources of disturbance will cease. Wildlife habitat will not be affected as the birds can simply feed on banks and in waters adjacent to the construction area.

The flood storage capacity will not be affected by construction as the water flow is controlled by the dam further downstream.

[Construction impacts to navigation on the Charles River are addressed in Section 20.2.1(e).]

20.2.6(d) Millers River

Actions taking place in the Millers River during construction that can have water resource, ecology, and wetlands impacts have been identified as the following:

- Filling
- Inland wetland resource area work

Filling. Ramps will cross over the Millers River and will require the construction of piers in that waterway. These new piers will result in the filling of water by structures. While this is unavoidable, the filling will have no impact of flood passage as the outlet from the Millers River to the Charles River and the elevation of the Charles River are the controlling mechanisms.

Inland Wetland Resource Areas. The resource functions that the Millers River performs are:

- flood control capacity
- storm damage prevention
- prevention of pollution
- fisheries habitat
- wildlife habitat

During construction, the banks of the Millers River will be disturbed. However, the banks will be restored to the greatest extent possible when construction is completed. This will include revegetation and riprap, reinforcing the already eroding banks. Further mitigation will also be provided as described in Chapter 14.

The Millers River is moderately important for flood control and storm damage prevention. Construction in this resource area will not greatly affect its performance as such due to its relatively high banks. The banks also contain wetland vegetation which will be disturbed as well. However, the low-quality reed grass stands do provide, to a limited extent, flood control and storm damage prevention by anchoring the banks and slowing water speeds. They also help minimize pollution by filtering the sediments. These reed grasses will be lost during construction. Mitigation will be provided as described in Chapter 14.

Millers River is not important as a fisheries habitat. However, the reed grass stands provide some wildlife habitat. These reed grass stands will be restored to the greatest extent possible at the completion of construction.

Construction of the new bridge piers will result in temporary impacts to land under the water, due primarily to turbidity and sedimentation.

20.2.6(e) Projectwide Impact Issues

Construction-related water resource, ecology, and wetlands impact issues that have been identified as taking place on a projectwide basis are:

- Construction drainage
- Dewatering
- Seawater usage
- Terrestrial plants, wildlife, and endangered species

Construction Drainage. Drainage of runoff from construction areas will take place throughout the construction areas. Surface drainage will be directed to existing storm sewers. Impacts to water quality could be derived from suspended solids or spills.

Sedimentation due to runoff discharge will, in some locations such as truck roadways, be unavoidable. It will be more common during the initial stages of excavation and earth movement. However, with construction progressing in a downward direction, runoff will be less of a problem in the depressed construction areas than it would be at conventional above-ground sites.

Spills of fuels and other materials are possible during refueling, maintenance operations, vehicle accidents, and material transfer. In order to minimize the potential of spills as much as possible, each construction contractor will be required to submit plans with specific procedures to be followed during construction to include the designation of fuel storage, refueling, and maintenance areas, and to implement an inspection program and procedures to deal with accidental spills.

Dewatering. Precipitation and groundwater withdrawal will be the sources of water to be disposed of by dewatering activities. Precipitation will produce the largest volume of water that will be handled by dewatering activity during construction.

The quality of water derived from dewatering will vary from one location to the next. In some locations, there will be no contamination present. Flow of seepage water into the excavation will be minimized by the use of relatively impervious support walls. In most cases these will be slurry walls or sheet pile walls that will minimize the inflow of groundwater. Therefore, contamination by seepage water will be minimal. In addition to those water quality parameters identified in Chapter 13, suspended solids will be a common pollutant. Suspended solids will be removed by use of sedimentation basins.

Water pumped from dewatering basins within the excavation area will be reintroduced to the ground to maintain groundwater elevations. Surplus water, i.e., primarily surface runoff, will have to be disposed either into the sewer system or into adjacent surface waters.

During the construction dewatering activities, construction contractors will be required to maintain the water table level outside their excavation area as close as possible to the normal fluctuation range to avoid impacts on foundations.

Seawater Users. There will be a number of industrial seawater users directly impacted during the construction phase. These include:

- o Gillette Company
- o James Hook & Company
- o Neptune Lobster
- o New England Aquarium
- o General Ship

To ensure that operations of the Gillette Company continue through construction, their intake will be relocated downstream of the construction work area to the Gillette property line. To provide additional protection from turbidity caused by dredging and tugboats, a silt barrier will also be installed as a part of the program. Close coordination with the Gillette Company will take place during the construction phase.

The James Hook & Company (Hook Lobster) and Neptune Lobster (each at opposite ends of the Northern Avenue bridge over Fort Point Channel) will be affected by tugboat operations and activity at the barge loading site. The anticipated impacts will consist of suspended solids (and potential ancillary problems with dissolved oxygen) which could jeopardize the ability to provide suitable water for tanks of lobsters, crabs, and shellfish. Both facilities have their seawater intakes along the Northern Avenue bridge, and both have been affected in the past due to tugboat movements and adjacent dredging operations. Mitigation measures will be instituted to control suspended solids.

The New England Aquarium has its seawater intake approximately 4 feet off the Harbor bottom and 1,700 feet from the Northern Avenue bridge. Suspended solid loads have increased in the seawater in the past as a result of storms and adjacent dredging operations. Impacts to the New England Aquarium, however, can be better managed through the water filtration system that has been installed at the facility, and monitoring of incoming water.

General Ship has an intake located at the northwest corner of Pier 5 that provides water for fire protection. Given this application of the water, its quality is not as sensitive an issue as that of other seawater users in the Harbor and can be adequately protected through the use of silt curtains around the intake location.

Seawater users on the Fish Pier (Massport and Harbor Lobster) and the adjacent Yankee Lobster may be periodically impacted from increases in turbidity. As was the case with the other areas, the water quality monitoring plan is designed to detect potential problems at these outlying areas.

Given the anticipated extent of the turbidity plume, Bethlehem Steel, Hines and Smart, and Bay State Lobster are expected to be outside of any influence of the project.

Terrestrial Plants, Wildlife, And Endangered Species. Construction-related impacts to plants and wildlife will be minimal. All species inhabiting the project and nearby areas are successional species that are quite adaptable to disturbances. Following construction, repopulation will proceed quickly unless an area has been totally built up or is to be maintained in a landscaped manner.

As discussed in Chapter 16, peregrine falcons are known to perch on high-rise buildings in downtown Boston While no falcons have been reported in the structure of the Charles River Bridge, they are known to frequent much higher bridge structures in other cities. Removal of the existing Charles River Bridge might potentially affect falcon habitat, at least until the replacement bridge is completed.

20.2.7 Aesthetic And Visual Considerations

Construction projects generally are not of sufficient size and duration to warrant extensive consideration of visual and aesthetic impacts and the implementation of specific visual mitigation programs. However, since construction activities for Boston's Central Artery and Third Harbor Tunnel will span some 9 years and occur throughout five major subareas, one of which is the City's downtown, the aesthetic qualities of such facilities -- even if they are temporary -- merit consideration.

Visual and aesthetic impacts generally relate to temporary changes in the environment, which can sometimes be interpreted as both positive and negative, depending on the type and extent of change, and the perception of the viewer. For example, a construction site filled with different pieces of equipment and bustling with activity can be a negative visual and aesthetic experience for some, and an exciting form of public street theater for others. Tours, viewing platforms, recorded messages, signs, maps, displays and other innovative tools to be developed during the design phase of the project will create an attraction for residents and tourists alike.

20.2.7(a) Concrete Batch Plants

A new concrete batch plant is planned to supplement existing facilities in the greater Boston area in East Boston. This plant will be located in what will eventually be the infield of the I-90/Airport Access Road interchange (see Figure 20.4).

This is an open-air operation and will be in a relatively visible location. The plant will be seen by persons driving to and from the airport. It will also be visible from Terminal A, Memorial Park, and the Hilton Hotel.

20.2.7(b) Barge Loading Facilities

Most of the project's excavated material will be transported from construction areas via four proposed temporary barge loading facilities: on the Charles River west of the North Washington Street bridge; on the north edge of Fort Point Channel between Congress Street and Northern Avenue; at Dry Dock #3 in the Boston Marine Industrial Park in South Boston; and at Bird Island Flats in East Boston (see Figure 20.5).

East of the Charles River facility, at Lovejoy Wharf, a slip is proposed for a potential ferry intended for commuters working in the Central Area. Adjacent to this slips there will be a commuter waiting room.

Barge loading facilities in East and South Boston will be located among other installations of similar character and scale. Surroundings of the sites for the other two facilities are urban in character. The Fort Point Channel facility will be visible from Museum Wharf to persons crossing the Northern Avenue and Congress Street bridges and from the Harbor Plaza building. The ramp at the Fort Point Channel facility will lie directly adjacent to the

Harbor Plaza building, but, as there are no windows at that level on that facade, the ramp will be visible only to occupants of upper stories looking directly down. The Charles River facility will be visible from the North Washington Street bridge, from the existing I-93 bridge and to pedestrians crossing the MDC locks from Charlestown.

20.2.7(c) Casting Basin

Because of the restrictive bridge/channel widths of the Fort Point Channel bridges, large immersed tube sections for the tunnel under the Channel will be fabricated in a casting basin on the east edge of the Channel between the shoreline and A Street (see Figure 20.7).

The facility will be located on property presently owned by Gillette and the Boston Wharf Company. It is presently used primarily for parking. The basin will be visible from a nearby six-story loft building having living/working accommodations for artists, other nearby loft buildings, Boston's main post office facility, and people crossing the Summer Street bridge.

20.2.7(d) Construction Areas

With the exception of the Third Harbor Tunnel alignment, the entire right-of-way for the Proposed Action will, at various times, become a construction area. The appearance in this zone will vary somewhat according to location and the phase of construction. For example, a large amount of construction will be conducted below grade in an open cut, or in tunnels below decked streets. The general activity throughout all phases will, however, be similar to other highway and building construction sites, with concrete trucks and flatbed trucks making deliveries, and dump trucks or a conveyor system hauling away excavated material.

Portions of the construction period right-of-way not taken up by construction activity may also serve as lay down area, or for detouring traffic and rerouting pedestrians.

In addition to the area within the construction period right-of-way, certain other sites have been identified for construction use. These sites were discussed previously in this section under traffic and transportation. Contractors for all subareas will also arrange for remote laydown areas on an individual basis.

20.2.7(e) Demolition

Demolition activity in the Area North of Causeway Street will be visible from adjacent streets, from buildings to the southeast, from the MDC locks, and from the existing Charles River bridge.

Once the new I-93 connection is complete, the existing Charles River bridge (I-93) will be dismantled. This activity will be visible from the new crossing, from the river, from the North Washington Street bridge, and to people crossing the locks from Charlestown. The existing I-93 elevated structure in Charlestown will also be demolished.

In the Central Area, the Artery viaduct will be removed as well. This demolition activity will result in short-term visual disruption, but will have a major positive visual impact on the downtown area over the long term.

In the I-93/I-90 Interchange area, the existing roadways and several structures will also be demolished. These are all located in industrial zones.

The I-90 alignment in South Boston requires demolition of existing roadways, bridges, and viaducts only where it intersects existing streets. Several buildings in South Boston will be demolished. The site of the Commercial Union will be used from mid-1991 to the end of 1992 for temporary parking to replace spaces lost to construction work in the BMIP.

In East Boston, a number of buildings will be demolished to make way for the I-90 connection between the Third Harbor Tunnel and the entrance to Logan Airport. These buildings are all located in what will become the I-90/airport access road interchange. These demolition activities will be visible to persons travelling along the present airport access and egress roads, as well as to occupants of the Hilton Hotel.

A second group of buildings will be demolished between the I-90/airport access road interchange and the I-90/Route 1A interchange. These activities will be visible to persons in East Boston Memorial Stadium Park, subway riders, motorists to the airport, air crews and passengers aboard airplanes, and residents along Porter Street southwest of the park and along Bremen Street, some 300 feet to the northwest.

20.2.7(f) Excavation

Excavation activities will have the greatest visual impact in the Central Area and in South Boston.

Initial excavation will take place in connection with relocation of utilities. In the Central Area, for example, 10 to 15 different sites will be opened for this purpose. Following utility relocation in the Central Area, trenches will be dug for slurry walls running along the length of the right-of-way.

As slurry walls are completed, excavation will begin. Each segment will be decked over once excavation has reached sufficient depth to provide work space below the deck. Subsequent excavation that takes place under decking will be out of view. Cranes will be used to load material into trucks in certain locations. In a few areas under the present Artery where there are no streets or pedestrian ways, contractors may choose not to use decking. Excavation in these portions of the Central Area and in South and East Boston will be visible throughout the duration of construction in these areas. The potential for dirt, mud and dust impacts on streets will be minimized by washing wheels of trucks as they leave the construction site.

A conveyor system may be used at some locations to help transport excavated material to barge sites. The conveyor would run through a box framework approximately 8 feet high attached to the side of the present Artery structure where possible. The conveyor could enclose the excavated material to prevent it from dropping onto streets or sidewalks below. Vertical conveyors would connect the main conveyor to sites being excavated (see Figure 20.8).

20.2.7(g) Underpinning And Retaining Walls

Underpinning of existing structures will be required throughout the Central Area and at certain locations in other subareas.

In the Central Area, underpinning of buildings will, with a few possible exceptions, not be visible once they are in place. Some underpinning of the existing Artery structure will, however, be visible.

At locations where new roadways join existing roadways, underpinning of existing roadway structures will be required. Roadway underpinning will be particularly evident at the I-93/I-90 Interchange. This underpinning will occur within the construction right-of-way and will be perceived as but another element of the construction process. The Red Line will require underpinning as I-93 northbound passes below it at Summer Street, but this work will not be visible from the street level.

Sheet piling, slurry walls, or tangent pile walls will be used as retaining walls for excavated areas in the Area North of Causeway Street and in South and East Boston.

20.2.7(h) Lighting For Night Shifts

During periods of peak construction activity, a second, and sometimes a third shift will be required. For these night shifts, high levels of lighting will be required. For areas of major activity, such as the casting basin, the total amount of light will be substantial and will be visible both from adjacent properties and from a distance as a general glow.

20.2.7(i) Movement Of Construction Equipment And Materials

Construction materials transported to and from construction sites will be primarily of three types: excavated material, concrete, and other building materials such as steel.

Excavated material will move along the right-of-way and roads designated for truck traffic to barge loading facilities. The East Boston concrete batch plant is strategically located adjacent to the right-of-way so that concrete trucks will also travel primarily along the alignment or on designated truck routes. Trucks bringing sand and aggregate to the batch plant will enter the metropolitan area on Route 1A. Trucks bringing in steel and other materials will enter the metropolitan area on I-90, I-93, or Route 1A arterials and proceed to lay down areas, where materials will be stored until required or proceed directly to the construction site. The primary visual impact outside the right-of-way will, therefore, be of trucks bringing in sand and aggregate, and of flatbed trucks moving along Routes I-90, I-93, and 1A.

20.2.7(j) Disturbance Of Landscape

The only landscaped areas of existing parkland to be disturbed by the Proposed Action are located in Leverett Circle, a traffic rotary, and along the east side of Storrow Drive, both of which are a part of the Charles River Basin reservation. Landscaping in the Circle consists of bushes, shrubs and flowers and, along Storrow Drive, of trees.

Existing parkland areas to be disturbed include the paved parking lot at the Paul Revere Landing Park (south bank of the Charles River) and the paved area under the elevated airport access road and airport bus loop ramp at the East Boston Memorial Stadium Park. Neither of these areas is landscaped. While a portion of parkland property along the surface segment of the airport access road will be disturbed during its removal, the adjacent area to be affected is not landscaped. A strip of landscaped area along the north edge of the East Boston Memorial Stadium Park will be disturbed temporarily; however, no trees will be affected.

The Proposed Action will disturb to varying degrees assorted trees elsewhere adjacent to the project right-of-way, primarily in downtown Boston.

20.2.7(k) Temporary Bridges, Ramps, Roadways, And Pedestrian Walkways

In the Area North of Causeway Street, a temporary viaduct north of the present viaduct will be constructed to carry traffic from Storrow Drive while the permanent viaduct is under construction. It will probably be a steel frame structure with precast concrete decking.

Temporary access ramps will be required in the Central Area to reach the existing Central Artery. Ramps will probably be constructed of pre-cast concrete decks on steel frames. Pier supports will not be uniformly spaced. Ramp locations will be in the same general vicinity as at present and will be similarly visible (see Figure 20.32).

In the I-93/I-90 Interchange area, temporary bridges will be required at the Dorchester Avenue crossing of Fort Point Channel and at Albany Street over the turnpike and railroad tracks. These spans will probably be Bailey bridges, a type of steel truss bridge which is fabricated from components kept on hand (see Figure 20.33). Such bridges will be compatible with the historic truss bridges already in the area and with other surrounding features. Other temporary bridges will be needed for short-term railroad diversions and for traffic detours.

In South Boston, a temporary Summer Street bridge and surface road will be built where it intersects the construction right-of-way. This will probably be a Bailey bridge also. A through-truss bridge already exists on Summer Street and fits well within the local context.

Temporary roadways will be required at various locations throughout the construction right-of-way. Where conditions warrant, roadways will be paved with asphalt and have sidewalks, curbs, and gutters.

Designs for temporary walkways will be varied to fit particular situations. Wheelchair accessible ramps will be provided for the physically handicapped. Walkways passing under, or close to, construction activities will be enclosed for the protection of pedestrians.

20.2.7(1) Temporary Access To Public Transportation

Entrances to five MBTA rapid transit stations will be affected by construction: Community College, Science Park, Haymarket, Aquarium, and Airport. Reconstruction of the Haymarket station entrance located on Parcel 7 will require that it be closed for 3 to 4 months, during which time riders will use the Government Center Garage station entrance. Some bus stops will be relocated during construction.

There will be safe, weather-protected, well lighted walkways with appropriate signage leading to all MBTA stations. Providing attractive and easily identifiable entrances to MBTA stations will be a high priority for the project during the construction period because of the anticipated increase in demand for public transportation.

20.2.7(m) Temporary Signs

Signs will be installed to inform drivers and pedestrians of detours and relocated facilities, as well as to explain construction activities. Large numbers of signs in the Central Area will require careful coordination of signing activity.

20.2.7(n) Anchored Barges

Construction of the Third Harbor Tunnel involves building tunnel sections on land, towing them to the Boston Inner Harbor, and lowering them into a trench dug across the Harbor bottom. Tunnel immersion construction activities will be conducted from barges temporarily anchored in the Harbor. These barges will be visible from the Boston Marine Industrial Park and Piers 5, 6, and 7 in South Boston and from Bird Island Flats in East Boston. Both of these are industrial areas where working vessels are a familiar sight (see Figure 20.34).

Some work on the Fort Point Channel immersed tube crossing will also take place from anchored barges. These will be visually compatible with the surrounding day-to-day working marine environment.

20.2.7(o) Barricades And Fences

Throughout the construction period numerous short- and long-term shifts in vehicular and pedestrian paths will occur both within and in the vicinity of the construction right-of-way. In addition, numerous areas adjacent to roadways and sidewalks will be cordoned off at construction sites and construction lay down areas. Traditional devices for such closures are wood and chain link fences and jersey barriers.

20.2.7(p) Motorist/Pedestrian Visual Experiences

Motorists and pedestrians passing through or near the project right-of-way will experience a changing urban scene. I-93 is a primary means of automobile access for persons entering the downtown area. Although the route will be open throughout the construction period, the area beneath the elevated highway will essentially become a construction site. At the I-93/I-90 Interchange, motorists will see two ventilation buildings under construction, underpinnings of the I-93 roadway, and the tunnel excavation.

In the Central Area, the right-of-way passes through areas of intense pedestrian circulation. Workers, shoppers, tourists, and downtown residents will all be making their way through and around the construction activities taking place in the right-of-way.

20.2.8 Historic Resources And Archaeology

20.2.8(a) Historic Resources

During construction of the Artery/Tunnel Project, various construction activities could create conditions which would adversely affect historic resources adjacent to the construction area. These activities and their attributes are summarized here. (All potential impacts to historic structures are presented in Chapter 10.)

In 1984, the Department, FHWA, the State Historic Preservation Officer (SHPO), the Boston Landmarks Commission (BLC), and the Advisory Council on Historic Preservation signed a memorandum of agreement (MOA) which stipulates measures to mitigate adverse effects to historic resources. Stipulation #4, Review of Design and Construction Specifications, states that "FHWA will ensure that potential adverse construction effects on all historic properties described in its Preliminary Case Report are minimized or avoided through appropriate preliminary and final design and construction specifications, reviewed and approved by the SHPO in consultation with the BLC, and through the appointment to the project design team by the MDPW a Project Conservator. The Project Conservator's job description and qualification shall be approved and his/her ongoing responsibilities reviewed by the SHPO in consultation with the BLC. The Conservator's responsibilities shall involve overseeing the development of measures for mitigating the adverse effects of construction on standing historic properties. These mitigating measures shall be included as part of the construction specifications."

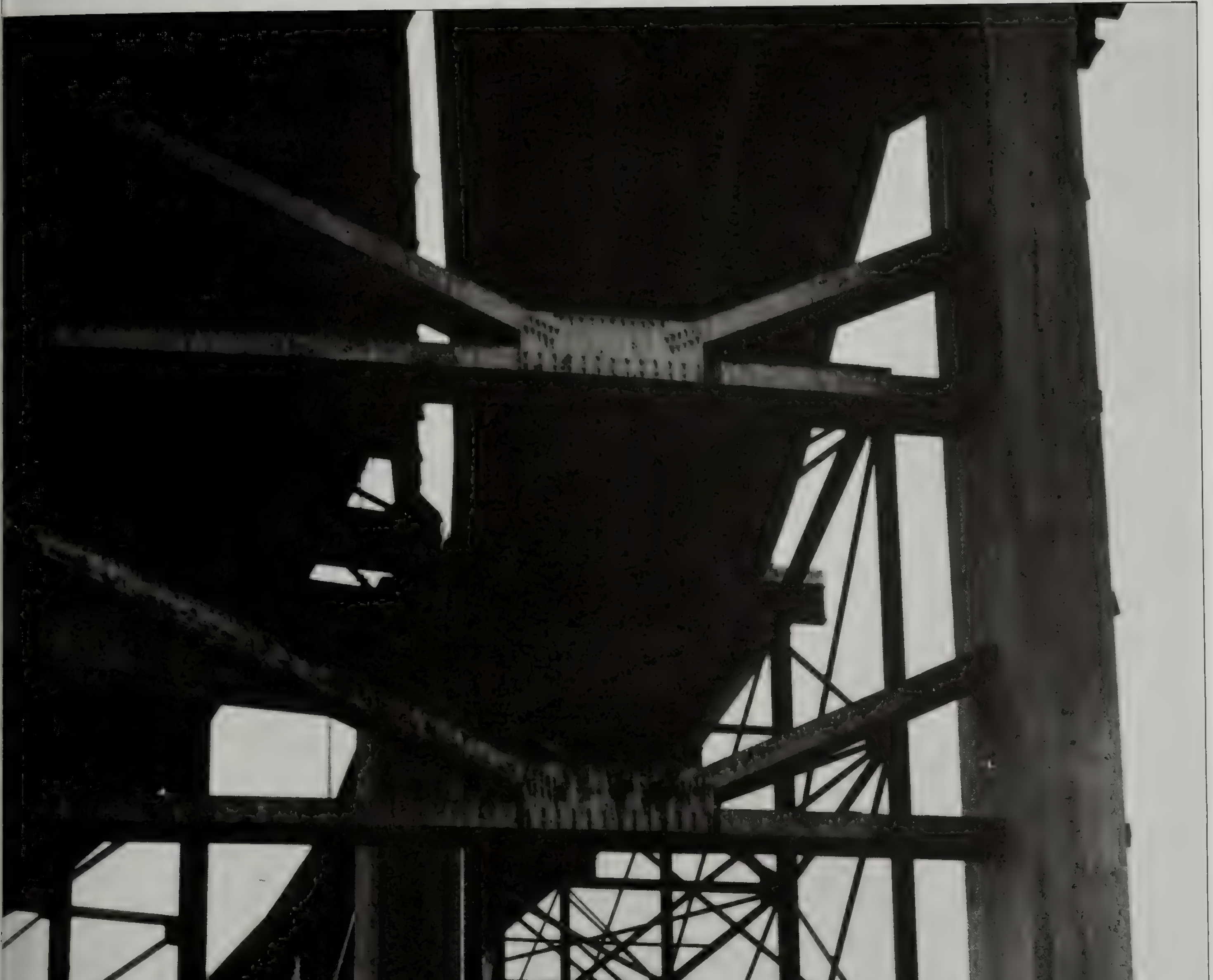


FIGURE
20.32

CANA Ramp (Example Of A Temporary Ramp)

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

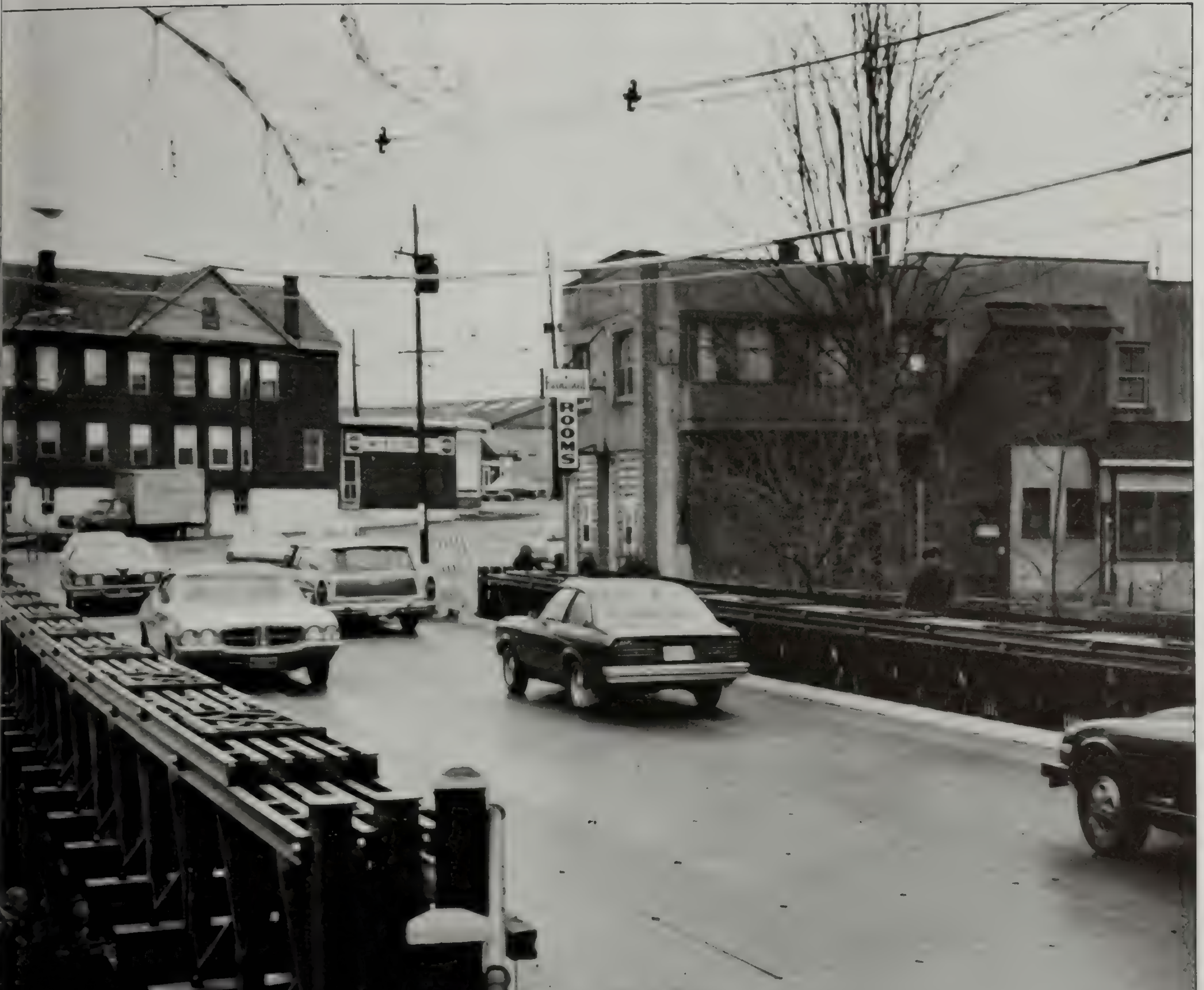


FIGURE 20.33 **Temporary Panel Bridge**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

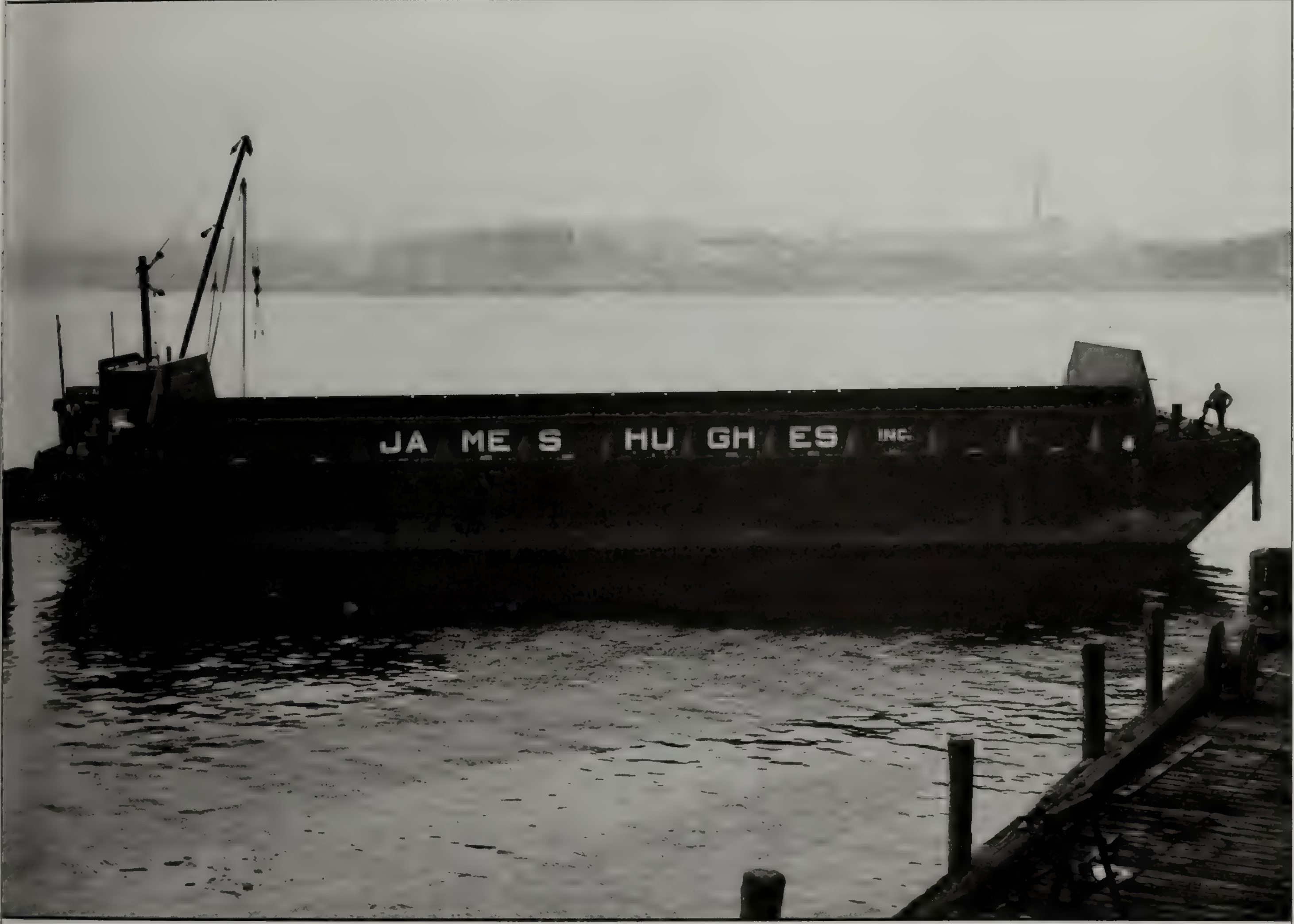


FIGURE
20.34 **Typical Barge**

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

In 1988 the Department, with the review and approval of the SHPO and BLC, appointed a Project Conservator to the design team. Preliminary Report of the Project Conservator: Potential Construction Period Effects to Historic Resources (McGinley Hart and Associates, 1988), has been produced. In that report the Project Conservator performed preliminary architectural-historical, structural and geotechnical analyses of all historic resources adjacent to or in the project area. The impacts to these structures would relate to potential effects of unmitigated vibration levels, alteration of groundwater levels, and/or uncontrolled ground movement during construction.

Review of the Project Conservator's Report by project engineers has resulted in additional detail and identification of specific potential effects to historic resources which are described below.

Construction Vibration. The potential effects due to the operation of construction equipment are described in Section 20.2.5.

Groundwater Conditions And Dewatering. The groundwater levels along the project alignment range from 6 to 10 feet below surface. Temporary or permanent lowering or raising of the groundwater table have been shown to adversely affect buildings, streets, and underground utilities. Much of the project alignment crosses portions of historic Boston Harbor, filled over the years to create developable land. Many of the historic structures along the project area are built on wooden piles or on wood wharves constructed in the 17th through 19th centuries. Potential problems from groundwater fluctuation could include deterioration of wood piles, ground subsidence, and negative friction (drag) on piles.

The project design is committed to preventing or minimizing effects to all structures, through design and construction specifications. These will be reviewed by the Project Conservator.

20.2.8(b) Archaeology

An extensive survey of archaeological resources has been conducted for this project, including field sampling and digs initiated in November 1988 within the right-of-way. (This program and its results are described in Chapter 11.)

The field investigation located three significant archaeological sites in archaeological study block NE03 near the North End. They are the Mill Pond Wharf site, the Paddy's Alley site, and the Cross Street Backlot site (see Figure 11.2).

The three sites previously described will be adversely affected by the excavation required for construction of the north- and southbound tunnel boxes for the I-93 Central Artery tunnel.

20.2.9 Nuisance Abatement

Potential nuisances associated with construction include pests (such as rodents and cockroaches) and odors associated with construction and excavation activities. Rodent control was one of the commitments made in the FEIS/R to minimize disruptive influences of construction. As a result of the high priority given this issue, a comprehensive nuisance abatement strategy is being developed for the project focusing on rodent and cockroach control. This strategy will be refined and implemented relying on the full cooperation of local residents and the City.

20.2.9(a) Rodent Control

The development and implementation of the rodent control program for the Artery/Tunnel Project is unique. This is the first time in the United States that a comprehensive rodent control program has been developed and implemented as a part of a major construction project. In addition, for the first time in Massachusetts, a team of leading authorities in rodent control has been engaged to provide the latest technology and state-of-the-art control practices, bringing their expertise to bear on this subject. Their comprehensive recommendations can be found in The Planning Report on Rodent Control and Management, November 1988. Finally, a full-time staff scientist, who is a specialist in rodent control, will coordinate the control program.

Like any older urban area, Boston has an existing rodent population consisting of Norway rats and house mice. Under certain circumstances, these rodents can migrate during construction. This phenomenon, however, is avoidable through application of up-to-date rodent control procedures. The goals of the control program are to eliminate rodent activity within the work areas (and thereby prevent any rodent displacement to immediate neighborhoods) and, subsequently, to prevent work areas from becoming reinfested by rodents immigrating from bordering blocks.

Historically, in Boston, it has been the responsibility of the construction contractor to hire a pest control operator to implement rodent control. Most of the control efforts focused on the actual construction period and were limited in scope. In distinct contrast, the professional pest control operators employed for this project will be contracted directly by the Department. Control efforts will begin prior to construction, and a comprehensive control program tailored to the environment will be implemented and maintained for the duration of the project.

Rodent control for the project will involve an Integrated Pest Management Plan (IPM) as described in the above-referenced Planning Report and summarized here. Integrated Pest Management is a form of applied ecology. It involves recognizing the resources that support rodents and uses a combination of techniques to maximize the control effort. An integrated control plan includes sanitation, rodent-proofing, poison baiting, and public education. These techniques and procedures will be designed to virtually eliminate rodents in the proposed work areas prior to construction and to maintain rodent-free areas during construction (see Figure 20.35). The integration of IPM activities and their distribution along the construction route will be based upon construction activities, the know efficacy of control procedures, and ecological factors such as human population density, sanitation levels, and the distribution and density of rodent infestations.

Sanitation. Increased sanitation efforts will be implemented along the alignment prior to construction and throughout the construction period. This will involve the assistance of the City's Inspectional Services Department and Code Enforcement Police in abatement of sanitation deficiencies. These agencies will enforce the State Sanitary Code and City Sanitation Ordinances in proposed work areas and bordering blocks. In addition, specially designed refuse receptacles will be used in the work areas to properly dispose of food left by construction workers. On-site sanitation will be mandated for construction

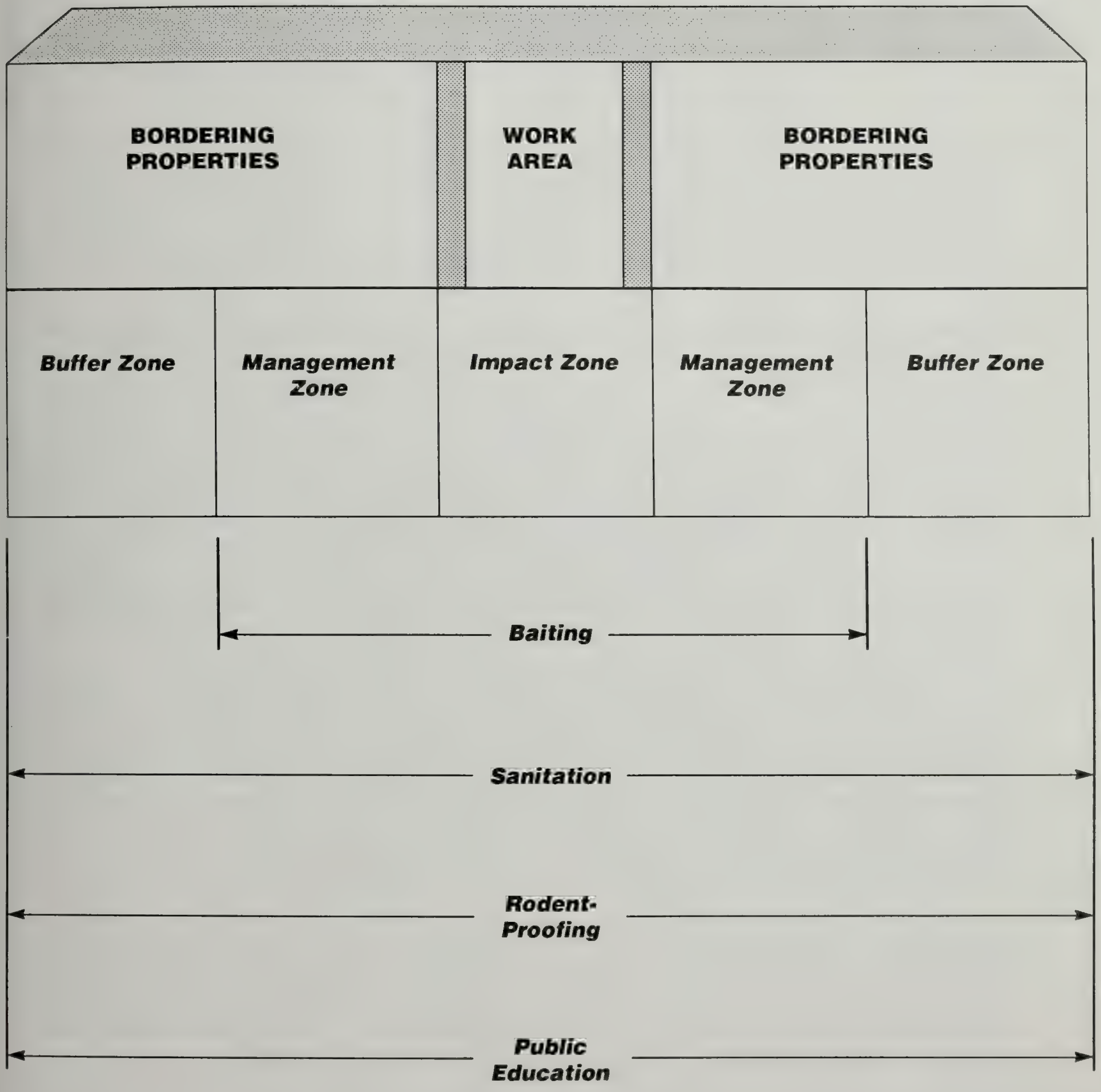


FIGURE
20.35 Integrated Pest Management Zones And Activities

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

contractors, including a preconstruction cleanup of any existing refuse. Such sanitation programs will be enforced by the Management Consultant's resident engineer throughout the construction period. Sanitation efforts also will include an emphasis on catchbasin cleaning in blocks along the construction corridor; this will involve the Boston Water and Sewer Commission and Massport.

Rodent-Proofing. Elimination of harborage and movement routes for rodents will be included in the IPM plan. Programs will include rodent-proofing, particularly of basements. This emphasis on basements is unique to Boston and will help eliminate movement routes currently available to rodents. Furthermore, conduit ducts in manholes, specifically identified as movement routes, will be sealed as appropriate. Construction design and final environmental planning will include review for rodent harborage and movement routes.

Public Education. Public awareness about rodent control will be a major component of the Artery/Tunnel Project, and specific educational programs will be implemented to supplement the general public education efforts currently maintained by the City of Boston.

Educational programs will emphasize sanitation and rodent control methods. Project staff, the Inspectional Services Department, and the Code Enforcement Police will be involved in these educational activities. Appropriate literature will be distributed to commercial and residential establishments, neighborhood presentations and demonstrations will be made, and communication with neighborhood organizations and public agencies will be maintained. Educational activities will begin as soon as possible in the expectation of being underway more than year prior to construction, and they will be maintained as needed according to sanitation conditions and rodent distribution patterns.

Baiting. Baiting programs will include rodenticides registered by the EPA and the Massachusetts Department of Food and Agriculture. All baiting will be conducted by licensed pest control operators in accordance with EPA-approved rodenticide labels. Baiting specifications that reflect current technology will be written, replacing out-of-date specifications historically used for construction projects. Surface baiting currently maintained by the City's Inspectional Services Department will occur throughout the preconstruction and construction period. In addition, the project will initiate a comprehensive baiting program.

Prior to construction, test baiting in manholes will be done to help assess the abundance and distribution patterns of rodent populations. Combined with mapping of utility systems, those data will be used to determine baiting locations and the needed widths of baiting zones. Additionally, prior to construction, rats and mice will be tested for genetic resistance to anticoagulant rodenticide, so that the most effective baits can be used.

Extensive surface baiting will begin approximately 2 to 3 months prior to construction; this will include work areas and appropriate bordering areas. Extensive underground baiting will begin approximately 3 months prior to construction in any given area. This will be the first large-scale underground baiting program ever implemented in Boston. A maintenance baiting program (surface and subsurface) will be implemented throughout construction; it will include appropriate interception points and inspections for rodent activity and sanitation deficiencies. The intensity of all baiting will be correlated with the level of rodent infestation, which will be monitored continuously. Specific timing and locations of baiting will be based on environmental conditions and results of preconstruction survey data.

Pest control operators will be required to dispose of unconsumed rodenticide and dead rodents according to the rodenticide label and applicable regulations. In addition, they will be required to maintain and submit records on rodent populations and related baiting, including sites baited and types of rodenticides used. All baiting activities will be reviewed regularly for effectiveness and adherence to EPA guidelines. The contracting of pest control operators will be based on high standards in training and experience, both in vertebrate pest management and integrated pest management disciplines. Pest control operators contracted by the Department will meet regularly with the project's scientist and will be required to attend appropriate project orientation and training programs on rodent control.

Other Components Of The Rodent Control Program. Because environmental factors along the construction route vary from densely populated urban areas to the asphalt environment at Logan Airport, the width of the control zone will also have to be determined rationally. Minimum distances for the IPM program will range from about 600 to 700 feet to 1,000 feet or more, depending upon characteristics of the particular area and the type of control procedure (sewer baiting, surface baiting, sanitation, catchbasin cleaning). Distances used for surface baiting may differ from those used for underground baiting, and the type and intensity of control procedures in each neighborhood will again be tailored to the environment. The distribution of control efforts will be adjusted as necessary to assure comprehensive control.

Several techniques will be used to best orient control procedures and evaluate the program's success. These include standardized surveys of bordering blocks for sanitation deficiencies and rodent populations prior to construction and throughout the construction period. Also, there will be extensive monitoring of bait consumption patterns in utility systems. Control procedures and resources will be appropriately distributed based on such information. Data will be maintained on computer file and analyzed for trends in rodent populations and relationships to environmental factors.

Complaints about rodent problems or sanitation deficiencies near the construction corridor will be directed to the Inspectional Services Department and Code Enforcement Police, respectively. Evaluations by those agencies will then be made and appropriate actions initiated by them and pest control operators contracted by the project. Complaints pertaining to Massport properties will be directed to Massport management. Records will be maintained on all rodent-related complaint calls, and their relatedness to construction activities will be closely evaluated.

Each construction contractor will be required to have a pest control operator, as needed, for any laydown area that is outside the designated work area.

In addition, the program will include broad participation, involving three City agencies (Inspectional Services Department, Code Enforcement Police, and Boston Water and Sewer Commission), State agencies (the Department of Public Health, MBTA, and Massport), utility companies, pest control professionals, neighborhood organizations, and private citizens. Participation in the control program will be integrated to maximize the strengths of particular agencies, and thus to maximize the quality of the control program. Cooperation among participants will be an essential component of the overall program.

20.2.9(b) Cockroach Mitigation

Cockroach migration resulting from disturbance of nesting and food supply areas by demolition activity can be a problem. Demolition in downtown Boston has resulted in demonstrated cockroach migration to adjacent structures and could occur at selected sites throughout the project area.

During final design, all buildings scheduled for demolition will be surveyed to determine the potential for cockroach migration. When found necessary, demolition specifications would include spraying for cockroaches by the pest control firms responsible for baiting/poisoning mice and rats. The rodent control/cockroach control process can be carried out concurrently.

20.2.9(c) Odor Control

Truck and construction equipment exhaust emissions, as well as utility relocation and demolition at construction sites, staging areas, and along construction haul routes can potentially create temporary odors.

Exhaust odor impact from trucks is most effectively controlled by appropriate designation of construction haul routes to avoid public amenities (public parks, restaurants) and sensitive receptor locations (residential neighborhoods). Restrictions on truck idling are also helpful. These measures will be applied where appropriate, based on final project design.

Temporary odors can also be generated during excavation activities. Odors can originate from marine sediments and vary in nature depending on location. Sediments from Fort Point Channel are known to have a petroleum odor, while those in Boston Harbor will have a slight sulfide odor. Other marine sediments buried in the upper organic horizons under the Central Artery, South Boston, and Bird Island Flats could produce potentially strong sulfide odors. However, these odors will abate as excavation progresses deeper into the marine sediments.

Often, odor levels can be controlled through the application of chemical compounds. For example, potassium permanganate works well in reducing petroleum odors, while lime reduces pH and odor levels in soils with high sulfide content. These materials are either applied as a spray, or spread dry on the sediments whenever odor becomes a problem.

Potential odor producing sediments can be identified during the design phase of the Artery/Tunnel Project through routine soil boring tests. Such testing will allow for the development of an adequate odor abatement program, including procedures and measures specified in construction contracts.

20.3 MITIGATION MEASURES

The project mitigation program includes measures that have already been identified, approved, and incorporated in the project design; new measures discussed in this document, and others that will be identified, analyzed, and addressed as the project evolves through final design and construction. The most important mitigation action will be to keep the existing highway and surface street system in full operation throughout construction. The achievement of this objective is vital to ensure continuous access to downtown Boston, and maintain traffic movement through the construction area. Other adopted measures include the South Boston Haul Road and barge loading facilities which will help minimize truck travel on Boston streets. An extensive program of public transit improvements, described in Chapter 3, is being implemented in advance of project construction. These improvements will accommodate increased transit utilization and provide the widest possible range of travel options during the construction period.

20.3.1 Mitigation Planning

A broad spectrum of mitigation measures is proposed in this document which are appropriate responses to the identified temporary disruption that will occur due to construction activities. These measures are being assessed currently, and the most appropriate actions will be adopted and incorporated into legally binding contract specifications and agreements, based on final design and public review and involvement. It is expected that additional measures will be identified and considered as the project evolves, including contingency measures and "quick response" actions that can be taken to address unanticipated events during construction.

The mitigation activities conducted during each project phase by the Mitigation Program Office and the construction management organization are summarized in Figure 20.36. These activities move from identification of preliminary strategies and potential measures; to public input and selection of site-specific strategies and measures for inclusion in contracts; to implementation, enforcement, monitoring, and contingency response. Three examples of the mitigation planning currently underway are presented here to illustrate typical situations involving important local issues (such as building access, traffic circulation, and critical pedestrian routes). The examples summarize how these situations are being addressed, and the type of solutions which may be adopted during final design.

Figure 20.37 shows how building access and local street vehicular access would be maintained at a typical location along the existing Artery. A planned sequence of construction will be developed in consultation with adjacent owners and others that would maintain utility operations, building access, and through traffic. This sequence would also consider environmental issues such as air and noise effects following procedures developed specifically for the project, described in the Maintenance of Traffic Plan Appendix.

Figure 20.38 shows how construction can proceed through a major intersection, with traffic shifted, accordingly, from one side of the street and intersection to the other. The sequence illustrates the changing extent of work areas and surface decking which necessitates temporary, short adjustments to normal traffic patterns, without interruption of normal traffic flows. However, the stage 4 illustration shows a temporary reduction in traffic capacity from two lanes in each direction to one lane. This condition could require mitigation, depending on the traffic volumes at this location, adjacent land uses, and other factors.

Similar mitigation planning is underway and will be refined and finalized following public input to ensure pedestrian circulation between downtown Boston and the waterfront, including the North End and other important locations such as the Aquarium, ferry terminals, hotels,

Preliminary Engineering

Mitigation Program Office (MPO) established to coordinate and operate mitigation activities. MPO will actively participate in meetings with groups and individuals impacted by the project to identify and incorporate issues and concerns into the development of mitigation measures project-wide as well as individual contracts.

Develop construction methods and techniques that reduce negative construction impacts.

Identify related projects and conduct planning and inventory assessments and resource availability to develop logistics plans that minimize material movements.

Conduct evaluation of preliminary design to determine the following potential impacts:
- traffic
- public transportation
- vehicular access
- pedestrian access
- vibration to buildings
- noise/air/odor
- nuisance
- parking
- historic resources
- right of way
- economic
- relationship to other construction activities

Develop implementation strategies to mitigate the impacts of construction.

Produce mitigation analysis report for final designer phase.

Final Design

Meet with Section Design Consultants (SDC) to integrate mitigation measures into the design. Determine specific areas with mitigation needs such as:

- traffic detours
- contractor access routes
- contractor construction and laydown areas and worker parking
- pedestrian walkways and access routes
- air quality mitigation requirements
- noise restrictions
- water quality requirements
- vibration restrictions

Review design documents to ensure that general and site specific mitigation measures are incorporated into the construction contracts.

Develop and finalize site specific mitigation measures in preparation for implementation. Utilize existing resources such as Transportation and Construction Coordinating Committee (TRANSCCOM) and TRANPLAN (transportation modeling software).

Produce mitigation specifications which includes requirements and guidelines for construction contract.

The project nuisance abatement and education program for rodent, cockroach and odor control will be implemented prior to construction start.

Continue to actively participate in meetings with groups and individuals impacted by the project. Focus on site specific issues.

MPO will coordinate mitigation activities between SDC designer, project engineers, community liaisons, and other interested parties.

Construction

Monitor construction contracts to assure compliance with all mitigation measures identified in the contract documents. Specific requirements include:

- Traffic-work plans will be required, reviewed, and evaluated for each phase of the operation. Contractors' activities will be monitored for compliance with approved plans and coordination of other construction activities.

- Pedestrian walkways and access routes - maintenance of suitable pedestrian walkways and access routes will be monitored.

- Contractor construction and laydown areas confining the operations to specified work limits will be monitored.

- Noise restrictions will be monitored regularly with hand held decibel meters.

- Vibration requirements will be monitored regularly with vibration measuring devices.

- Specified air quality and dust control requirements will be monitored.

- Specified water quality control measures will be monitored.

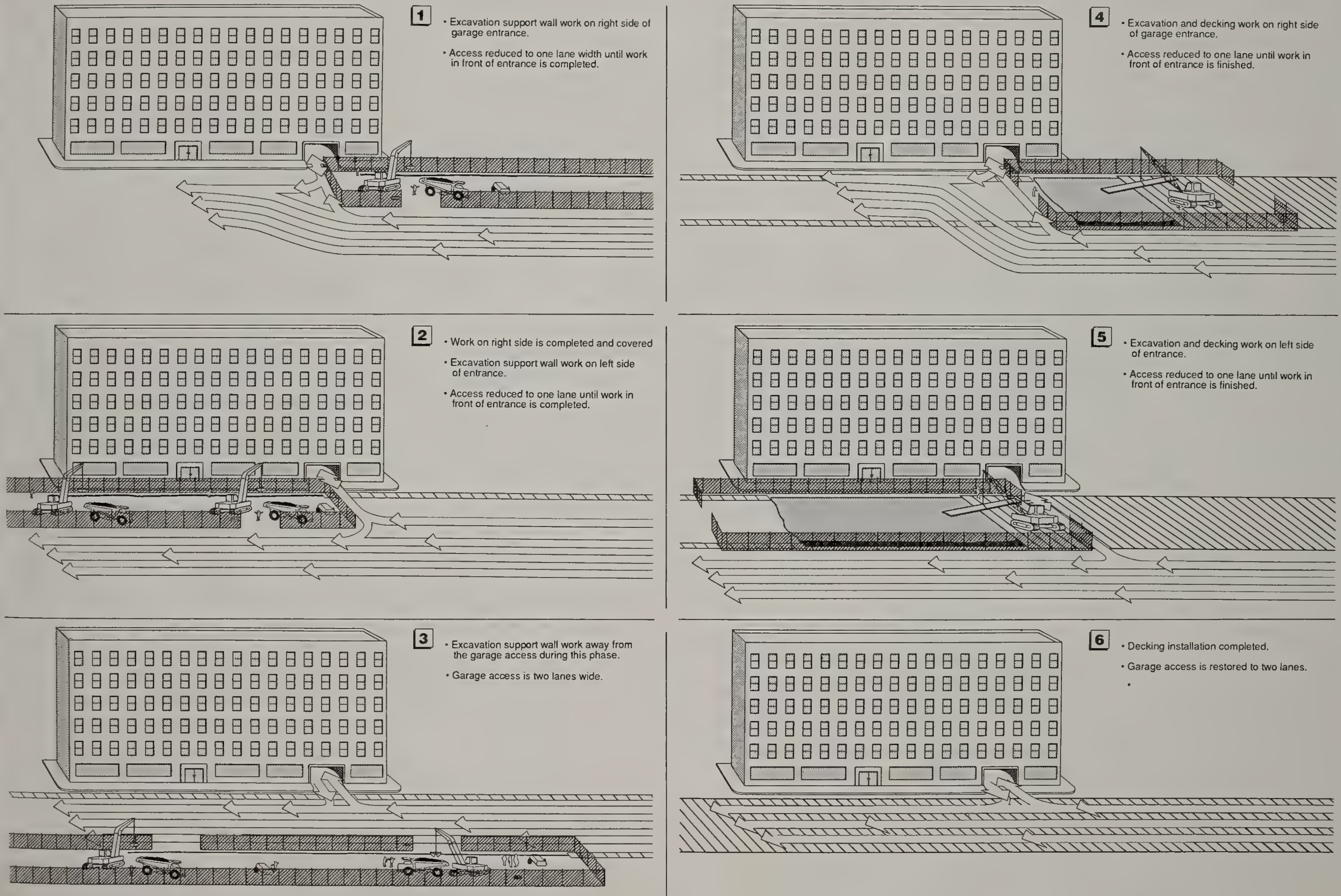
Continue to actively participate in meetings with groups and individuals impacted by the project to coordinate specific issues involving construction and impacted parties.

Continue to interface with TRANSCCOM to assess the effectiveness of the maintenance of traffic plan.

Continue to utilize the TRANPLAN transportation model to predict changes and modifications to traffic routing as they are proposed and modified during construction.

FIGURE
20.36

Construction Mitigation During Three Project Phases



1
- Excavation support wall work on right side of garage entrance.
- Access reduced to one lane width until work in front of entrance is completed.

2
- Work on right side is completed and covered
- Excavation support wall work on left side of entrance.
- Access reduced to one lane until work in front of entrance is completed.

3
- Excavation support wall work away from the garage access during this phase.
- Garage access is two lanes wide.

4
- Excavation and decking work on right side of garage entrance.
- Access reduced to one lane until work in front of entrance is finished.

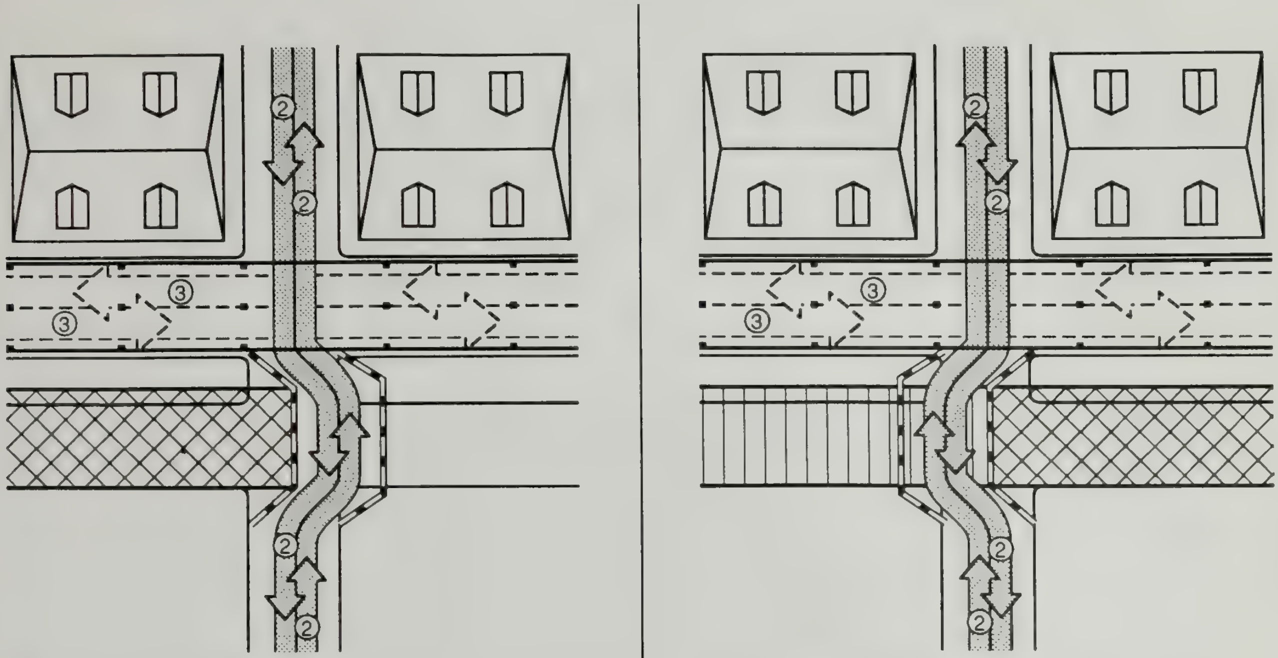
5
- Excavation and decking work on left side of entrance.
- Access reduced to one lane until work in front of entrance is finished.

6
- Decking installation completed.
- Garage access is restored to two lanes.

FIGURE
20.37

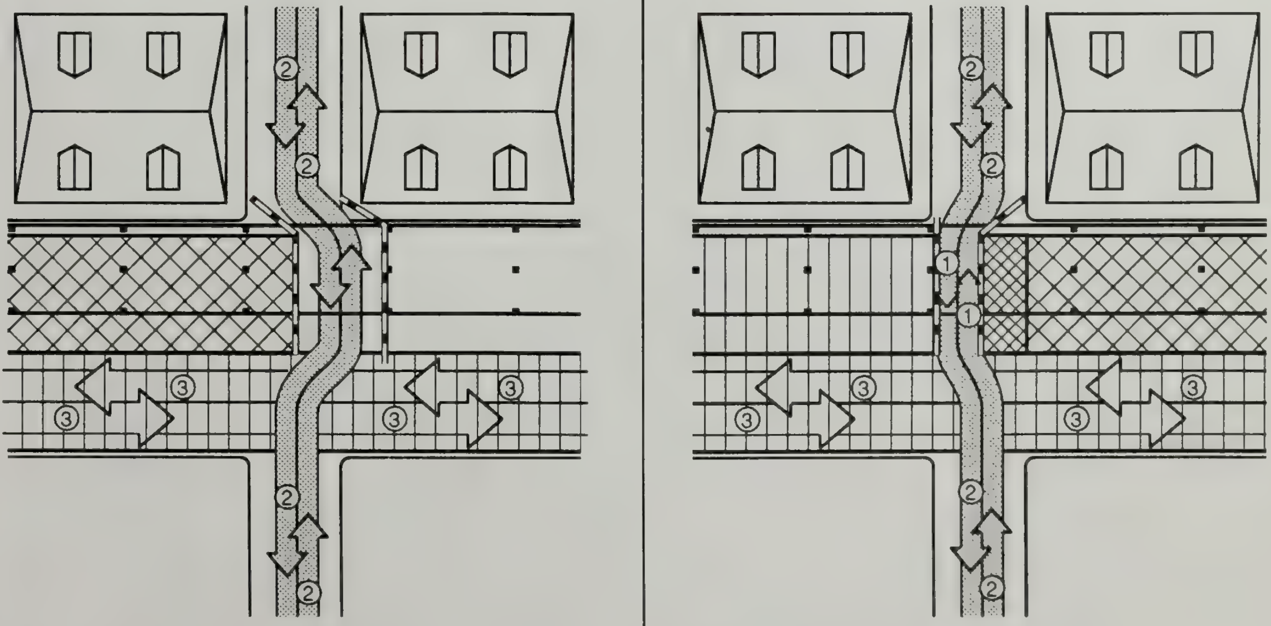
Construction Mitigation Example

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R



1 • Work occuring in lower left area.
• Traffic shifts to the right

2 • Work occuring in lower right area.
• Traffic shifts over new deck on left.



3 • Work occuring in upper left area.
• Traffic shifts to the right

4 • Work occuring in upper right area.
• Traffic shifts to left and is reduced to two lanes until work in the ▨ area is completed and full capacity is restored.

LEGEND	▨ Work Area	▥ Decking	② Lanes

FIGURE
20.38

Construction Mitigation Through A Typical Major Intersection

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Not to Scale

businesses, and residences. Figures 20.39, 20.40, and 20.41 illustrate how the project will maintain convenient, safe, and pleasant pedestrian routes between Haymarket and the North End, showing the existing walkway, temporary routings, and restoration of improved at-grade circulation with the completion of the project. In general, this will be accomplished by temporarily relocating walkways when necessary and by providing route information and barriers which are both protective and decorative.

20.3.2 Maintenance Of Traffic Plan

Pursuant to commitments made following the FEIS/R, a Maintenance of Traffic Plan is being developed as an integral part of the Construction Mitigation Program. This plan will include systemwide as well as subarea consideration of the most important traffic and pedestrian circulation issues and mitigation measures. It will be refined during final design and used as the basis for discussion with public agencies and affected local communities, and for guiding and coordinating maintenance of traffic.

At the systemwide level, maintenance of traffic will include a range of activities designed to: reduce vehicular traffic in the project area during the construction period, especially during high activity periods and within areas where construction is intense; and help motorists cope by providing them with travel options. Specifically, these activities will include mitigation strategies and measures to encourage high rates of transit ridership, improve traffic management, and provide public information as described in the Maintenance of Traffic Plan Appendix.

Local area maintenance of traffic will reinforce the projectwide activities by focusing on site-specific temporary problems. This program will include activities to: improve traffic at or near selected temporary detours or disruptions; and address related concerns and issues, such as potential temporary accessibility problems, air quality, and noise effects.

A wide range of mitigation measures are potentially applicable to each site-specific traffic condition. A preliminary assessment has been made of the measures which may be most appropriate for each potential traffic mitigation condition as a part of the preliminary Maintenance of Traffic Plan. These include the following:

- Alternate local routes
- On-duty uniformed traffic personnel
- Signalization
- Pavement markings and channelization
- Reduction/elimination of on-street parking
- Reversible traffic lanes
- Rescheduling of construction activities
- Decking over construction activities
- Improved signage
- Motorist information and traffic monitoring

Other measures may be suggested or proposed by local residents and adjacent property owners, or by cooperating public agencies. Potential traffic mitigation conditions and appropriate maintenance of traffic measures will be assessed and defined based on continued development of the Maintenance of Traffic Plan during final design.

Continued development of the Maintenance of Traffic Plan will be integrated with the activities of the Transportation and Construction Coordinating Committee (TRANSCCOM), a committee of representatives from 14 key City and State agencies co-chaired by the Commissioner of the Boston Transportation Department and the Secretary of the Executive Office of Transportation and Construction. This committee meets regularly to discuss and coordinate plans for private and public construction projects in the metropolitan area.

20.3.3 Mitigation Program Summary

The important mitigation program categories and measures to address impacts during construction are summarized below. They are described more fully in the Construction Mitigation program and Maintenance of Traffic Plan appendices.

Special Construction Methods And Equipment:

- Tunnel protection and bridge erection safety precautions will be taken.
- Investigations will be conducted during final design to evaluate the need for underpinning and/or other measures to insure the integrity of adjacent structures.
- A cross-lot bracing system will be required in many locations throughout the project.
- A detection-of-movements and deformations program will be established to monitor excavation, bracing installation, support walls, and adjacent structures.
- A dewatering program will be developed.
- A conveyor system may be used to move excavated soil in order to reduce the number of truck trips required.

Systemwide Maintenance Of Traffic:

- Overall project Maintenance of Traffic Plan.
- Eleven measures already incorporated in Proposed Action design, including full and continuing operation of the existing elevated Central Artery.
- Five measures to limit temporary parking impacts during construction.
- Ongoing program to:
  - increase transit ridership
  - improve traffic management
  - provide public information

Local Area Maintenance Of Traffic:

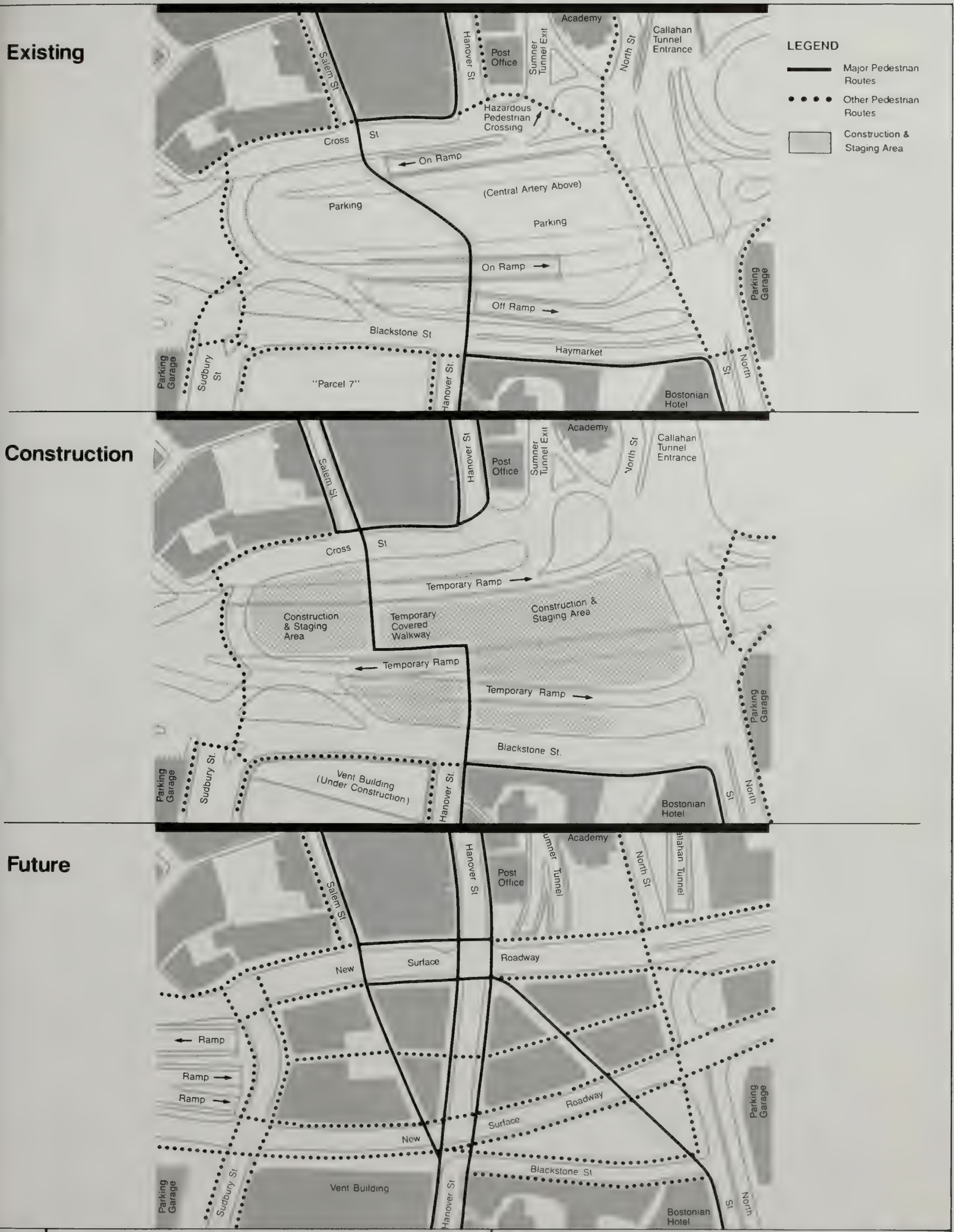
- Mitigation measures are proposed for 34 traffic conditions.
- A specific procedure will be used to assess these conditions during final design and determine the most appropriate mitigation measure(s).
- TRANSCCOM is proposed as an advisory mechanism for local area mitigation measures.

Pedestrian Circulation:

- Mitigation measures are proposed for 11 locations.
- Access will be maintained to all adjacent structures and affected facilities.
- Alternate pedestrian routes, including attractive, well lighted, and safe walkways will be provided around or through construction areas.

Public Transportation:

- Surface bus routes will be maintained.
- Mitigation measures are proposed for eight locations.


Existing

Construction

Future

FIGURE 20.39

Pedestrian Mitigation Example

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Birds-eye view looking to Downtown from Salem Street in the North End. The existing highway will be kept in operation during construction at and below grade. This peel-back view illustrates pedestrian walkways to provide safe access across the construction activities. Location of walkways will vary, but connections will always be maintained. Ventilation Building 4 is shown under construction in front of completed parking structure on Parcel 7.

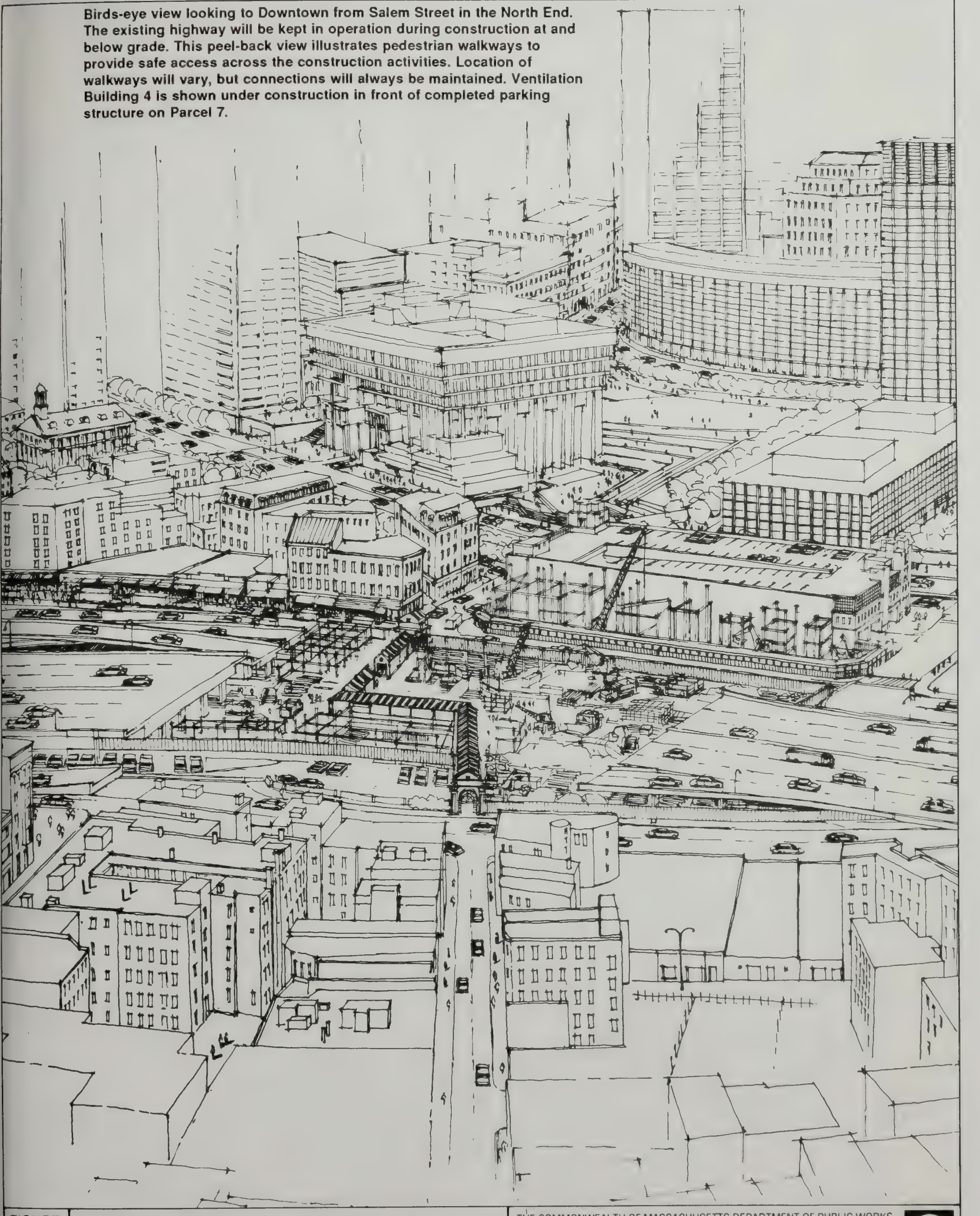
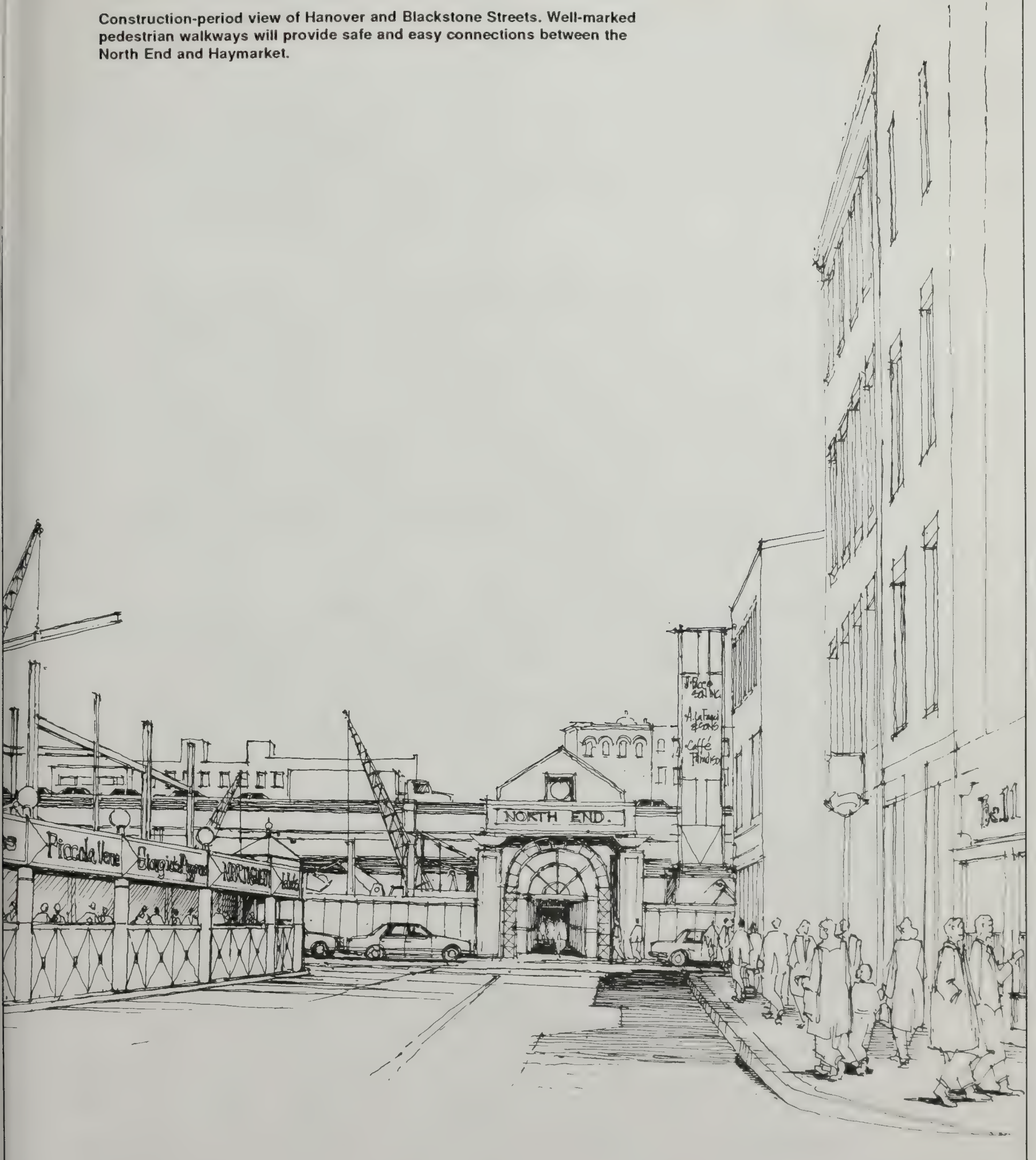


FIGURE
20.40

Aerial View Of Pedestrian Connection During Construction – Haymarket Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

Construction-period view of Hanover and Blackstone Streets. Well-marked pedestrian walkways will provide safe and easy connections between the North End and Haymarket.



FIGURE

20.41

Entrance To Construction Period Pedestrian Path – Haymarket Area

THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT
SUPPLEMENTAL EIS/R

- Special measures will be taken to protect transit tunnels and stations at six locations.

Navigation:

- Harbor navigation and access to docks, ferry terminals, and other water-related facilities will be maintained.
- Close coordination will be established with all public agencies having Harbor-related responsibilities, especially regarding navigation requirements, barge movements, and any anticipated hazardous conditions.

Economic:

- Location-specific measures, including access, safety, noise, and aesthetic requirements of adjacent businesses, will be identified during final design and incorporated into construction contracts.
- A public information program for commuters, tourists, local residents, and the business community is underway.
- A community and City agency mitigation involvement program will be initiated, including measures to protect and communicate with the homeless near the construction sites.
- Alternative modes of public transportation will be provided.
- A Building Opportunity (jobs) Program has been developed to ensure maximum local participation in the project.

Utilities:

- To the extent possible, utilities will be relocated before roadway/tunnel construction begins.
- Relocated utilities will be consolidated into corridors, where possible, to minimize disruption and facilitate maintenance.
- Unless required otherwise, existing utilities will be maintained in place.
- All utility work will be closely coordinated with utility companies and potentially affected users.

Air Quality:

- Nine mobile source abatement measures have already been included in project plans.
- Six additional measures will be considered as a part of continuing maintenance of traffic planning.
- Traditional and site-specific stationary source abatement measures will be employed for control of fugitive dust and emissions.

Noise And Vibration:

- Seven reasonable and feasible noise mitigation measures will be implemented.
- Seven vibration mitigation measures will be placed in operation.

Water Resources And Ecology:

- Specific actions will be taken to mitigate the negative affects of open water dredging in Boston Harbor and Fort Point Channel.
- A Sedimentation and Erosion Control Plan will be developed during final design.
- A Spill Containment Control and Countermeasure Plan will be prepared during final design. A spill cleanup firm will be under contract throughout the project to ensure timely response to spills.

- Measures will be taken to mitigate the negative affects of dewatering.
- A risk analysis is being conducted to determine the effects of 100-year flood conditions in Fort Point Channel.
- Close coordination will be maintained with potentially affected seawater users. Specific mitigation measures will be developed for the Gillette, Hook Lobster, and Neptune Lobster Companies, the General Ship Company, and the New England Aquarium, if required.
- An Underwater Blasting Control Plan will be developed to mitigate the negative effects of blasting on fish.
- A Wetland Mitigation Plan will be developed for Millers River including replacement and landscaping.

Aesthetic And Visual:

- All auxiliary facilities will be sited in a way that is visually and aesthetically compatible with their surroundings, where feasible.
- Orderly and clean work sites will be required and enforced throughout construction.
- A construction period arts program, emphasizing information and design assistance for motorists and pedestrians, is being developed. This program will be closely coordinated with the project public information program and Maintenance of Traffic Plan.
- Special fencing and/or landscaping will be provided at designated laydown and construction zones, and throughout the Central Area.
- Landscaping will be left in place and protected for as long as possible, and replaced as soon after construction as possible.
- A comprehensive sign system will be developed to help motorists and pedestrians move safely and smoothly through the construction area.
- Abatement of highly lighted areas during night shifts will be considered.

Historic Resources And Archaeology:

- A Project Conservator has been appointed to the design team to ensure that construction period negative impacts will be avoided or minimized.
- Historic buildings within 12 feet of slurry wall construction will be inspected and monitored and appropriate measures will be implemented, to mitigate potential effects of vibration.
- Where cosmetic or structural damage to historic buildings could occur, alternative pile driving and construction methods will be considered.
- Monitoring of groundwater and soil conditions will be undertaken in areas where hydrostatic uplift could affect historic buildings.
- Special construction methods will be used to prevent groundwater levels from fluctuating excessively.
- Data recovery will be performed at significant archaeological sites prior to construction.

Nuisance Abatement:

- A comprehensive project rodent control program has been developed and will be implemented, beginning with surface baiting 2 months prior to construction.
- All buildings to be demolished will be surveyed for cockroach migration potential, and appropriate abatement measures will be applied.

- Designation of construction haul routes, restrictions on truck idling, application of chemical compounds, and construction staging will be used to control temporary odor producing sources.

20.4 COMPARISON WITH FEIS/R

This section summarizes the key differences between the 1985 FEIS/R document and the current SEIS/R in terms of construction and temporary construction-related transportation and environmental effects. The discussion follows the same sequence of major topics covered in this chapter, Sections 20.1 through 20.3.

20.4.1 Construction Methods

Several design refinements, and numerous methods and special measures have been developed for the project which will result in faster, less expensive, and more efficiently managed construction.

- The 1985 FEIS/R described the construction of "H"-shaped concrete pile supports, comprised of several slurry panel segments, which provided a center support system used in underpinning the Artery. The current methods involve either a center slurry wall or a line of caissons located within the plane of the future tunnel wall, eliminating the need to construct and subsequently remove the massive "H"-shaped concrete slurry piles.

- The FEIS/R described these grade beams as being constructed of approximately 2 feet by 8 feet reinforced concrete members. Current plans include using steel plate girders which can be installed faster and with less disruption.

- Each existing Artery column within the tunnel excavation footprint will be supported by these grade beams. Again, refinements to the methods proposed in the FEIS/R have been developed. Rather than using needle beams, which must pass below the existing Artery footings, a direct column pickup is planned. In this method, above-ground beams will be used to form a collar around the column.

- The realignment of I-93 northbound from Fort Point Channel to Atlantic Avenue eliminates the need to fill portions of Fort Point Channel between West Fourth Street and Dorchester Avenue and the extension of the Roxbury Conduit, or close the Channel either during construction or as a result of the completed facility. However, it will be necessary to reduce the width of the Channel by approximately 150 feet at Dorchester Avenue tapering to much smaller reductions in width towards the Roxbury Conduit.

- Special methods and equipment have been identified since the FEIS/R, including MBTA tunnel protection; vibration monitoring; and tunnel fabrication, delivery, connection, and support alternatives.

- Other special measures may be considered and adopted during final design, including the use of available new technologies and a conveyor system for movement of excavated material.

- The major elements of the overall Project Construction Management Plan have been defined since the FEIS/R. They include the project construction program, scheduling, and control mechanisms, as well as the construction mitigation program and maintenance of traffic plan.

20.4.2 Traffic And Transportation

The FEIS/R provided a general discussion of traffic disruption resulting from project construction within each area, without reference to stage of construction, duration or severity of impact. The more detailed assessment in the SEIS/R is summarized as follows:

Detours And Diversions. The major vehicular and railroad detours necessitated by each stage of construction in the six project subareas have been identified and assessed, and appropriate mitigation measures proposed (a description of each detour and its location is presented in the appendix).

Maintenance Of Traffic Plan. A Preliminary Maintenance of Traffic Plan for vehicular and pedestrian circulation has been prepared and summarized in the appendix. Procedures have been outlined for continued development and refinement of this plan during final design in cooperation with public agencies and local communities. The implementation of this plan is a part of the overall project Construction Management Program.

Movement Of Materials. The FEIS/R presented a qualitative assessment of new truck traffic generated by construction of the project. For example, up to 1,000 trucks per day were estimated during the excavation stage in the Central Area. The SEIS/R provides a detailed assessment of construction material quantities, and average and peak truck loads per day by year for each project subarea. The SEIS/R also provides a number of truck traffic mitigation actions, including special haul routes to minimize travel on local streets.

Other Transportation. The SEIS/R presents a detailed discussion of the temporary construction effects on pedestrian circulation, public transportation, and navigation on waterways (Charles River, Fort Point Channel, Boston Inner Harbor) in the project area, which were not found in the FEIS/R.

20.4.3 Economic Effects

Regional Sales. In the FEIS/R, it was estimated that the Preferred Alternative would require a total expenditure of $3.0 billion in 1987 dollars ($2.6 billion in 1983 dollars), and that $4.95 billion (1987) of total industry sales would result. The REMI model (described in Chapter 5) used in the SEIS/R analysis projects $4.1 billion in total regional sales from an investment of $4.4 billion in the Proposed Action. The lower figure forecast by the REMI model takes better account of direct purchases from suppliers outside the region than could be done in the analysis used for the earlier FEIS/R. The availability of a detailed Interstate Cost Estimate for the Proposed Action made it possible to identify the major materials and equipment required for the project and to estimate the percent of imports that are expected to be required from outside the region. Roughly half of the total economic benefit will occur outside the Boston metropolitan area due to the project's demand for large quantities of steel, construction equipment, and other specialized goods and services which are not produced within the metropolitan area.

Employment. Total direct, indirect, and induced employment estimated in the FEIS/R was at 77,000 person years over 12 years (6,500 jobs per year average), which is somewhat higher in total than the 71,000 person years (8,900 per year average) currently estimated for the Proposed Action, which is a larger project with a shorter construction time than the FEIS/R Preferred Alternative. This difference is because the Proposed Action has a higher material content relative to labor content due to extensive tunnel construction and because a larger fraction of the new jobs is now projected to be created outside the region.

Retail Sales. The retail sales estimates have been revised to take account of the new, larger study area (with a larger retail base), new information on shoppers' mode of access, and recent case studies of other downtown construction projects. The latter element (particularly in reference to Seattle) represents the major difference from the FEIS/R results. This case indicates that carefully managed mitigation can limit losses to 2 to 5 percent of automobile-dependent sales, rather than the 10 to 20 percent losses stated in the FEIS/R. The SEIS/R analysis projects an approximate annual sales loss of $10 million over the much larger study area. In addition, the FEIS/R did not describe the sales gains resulting from the construction workforce and extra income to other workers, which are currently estimated at approximately $51 million per year for the metropolitan region.

20.4.4 Utilities

The SEIS/R presents a more thorough identification of utilities that will be affected by the Artery/Tunnel Project than that presented in the FEIS/R. The earlier review consisted of a list of affected utilities by project area. The SEIS/R discusses utility relocation scheduling, service disruptions, and construction traffic control measures. It includes a thorough discussion, by project area, of all relocation work, identifying all relocations and then explaining where individual utilities will be relocated. Wherever possible, utilities will be reorganized into permanent transverse and longitudinal corridors, located outside and across roadway alignments. Finally, the phasing of the relocations and utilities corridor work is discussed as it relates to the construction of the project.

The FEIS/R indicated that utility work in the Central Area would begin before the start of construction of Artery structures. However, in all other areas, utility work would be undertaken at the same time as Artery/Tunnel Project work and by the same contractors. The SEIS/R is more specific in its breakdown of utility relocation sequencing. The 1989 Supportive Engineering Report indicates that in the Central Area, from Congress to Causeway Streets, all relocations will be made under a separate contract prior to the commencement of construction of the Artery. From Kneeland to Congress Streets, utility relocations will be carried out by the general contractors. Moreover, the contracts will state clearly that relocations must be made before general construction work can begin.

In all other areas, relocation work will occur simultaneously with general construction work, with some important exceptions. Work will start early on the New East Side Interceptor, which will lie within the project limits in the South Bay area and outside project limits in the Central Area. Work will also begin early on the relocation of a major gas main entirely outside of project limits. In East Boston, the Porter Street outfall and a new electrical substation and sewer pump station will be built prior to the start of general project construction in that area.

Finally, the 1989 Supportive Engineering Report presents a comprehensive listing and corresponding figures of all utility relocations anticipated during the project and indicates which relocations were not included in the 1985 FEIS/R.

20.4.5 Air Quality

The SEIS/R presents a more detailed discussion of construction impacts on air quality than that presented in the FEIS/R, analyzing both mobile and stationary source emissions. Although the mobile source analysis does not assess specific construction traffic scenarios, a procedure for such an analysis is outlined in the Maintenance of Traffic Plan Appendix for traffic conditions that may require mitigation. This procedure will be applied as a part of continued maintenance of traffic and mitigation planning during final design. There was no discussion of specific traffic detours during construction in the FEIS/R.

The SEIS/R discussion of stationary source emissions addresses on-site construction equipment emissions, as well as fugitive dust generated by truck traffic, earthwork activities, demolitions, and concrete batch plants. The analysis provides estimates of daily truck traffic by subarea for the duration of the project and also presents results of the Gaussian dispersion procedure used to analyze effects of emissions from the ready-mix concrete batch plants. There was no discussion of the batch plants in the FEIS/R.

Discrete mitigation measures for mobile source emissions are presented in the SEIS/R. These measures have already been included in project plans, and will be incorporated into section design and construction contracts. Recommendations for additional mobile source abatement measures are also included. Final mitigation programs for individual traffic detours will be developed pursuant to the Maintenance of Traffic Plan in the appendix.

Several stationary source emission mitigation measures not presented in the FEIS/R are found in the SEIS/R. These measures include: watering at construction sites; use of tarpaulin on haul trucks; procedures to control emissions at concrete batch plants; special measures to prevent air emissions of friable asbestos materials (if found during demolition work); a speed reduction program for on-site construction vehicles to minimize fugitive dust; and a construction equipment maintenance program to minimize gaseous emissions on-site.

20.4.6 Noise And Vibration

Noise. The construction noise impact analysis presented in the SEIS/R is more detailed and complete than that found in the FEIS/R. The SEIS/R provides a detailed breakdown of the Artery/Tunnel Project schedule in order to identify how long different sections of the City will be subjected to construction noise impacts. The analysis also identifies stationary noise sources during construction. Specific sites that would be subjected to substantial, moderate, and minor noise impacts are identified. The discussion also indicates the duration of those impacts for selected sites. This analysis is based on project scheduling, expected noise levels, and the sensitivity of nearby receptors. The SEIS/R also discusses applicable City noise standards and criteria, and project compliance with those codes. General mitigation measures are recommended. A definitive mitigation program conforming to the City of Boston Noise Ordinance will be developed during the design phase.

Vibration. The SEIS/R identifies important vibration sources. The text discusses existing construction vibration criteria and the potential effects of vibration impacts to structures and local soil conditions. While structural damage is not expected at any buildings near the Proposed Action, the text lists structures where architectural damage is possible. The vibration analysis concludes with a list of vibration mitigation measures that will be included in section design contracts. These include a preconstruction survey, structural integrity inspection, and constant vibration monitoring during slurry wall construction at the sensitive structures in areas where intense construction activity will occur. None of the above mitigations were included in the FEIS/R.

20.4.7 Water Resources And Ecology

Surface Water. The SEIS/R estimates volumes of suspended solids that can be expected during the dredging of Boston Harbor and also explains how those materials will be distributed and will eventually resettle. Unlike the FEIS/R, the SEIS/R explains how bucket losses of dredged materials will be minimized and states that such mitigation measures as silt curtains will be evaluated during final design.

Chemical Impacts. The SEIS/R identifies possible chemical impacts to water quality due to spills and accidents during construction. These issues were not mentioned in the FEIS/R. The SEIS/R states that a Spill Containment Control and Countermeasure Plan will be prepared during the design phase, and that a spill cleanup firm will be retained during construction.

Seawater Usage. Unlike the FEIS/R, the SEIS/R classifies impacts on the use of seawater for industrial needs as a temporary construction impact. The SEIS/R identifies specific mitigation measures for the Gillette Company, and recommends possible mitigation measures for two firms (Hook Lobster and General Ship) which were not included in the 1985 document. The SEIS/R also recommends close coordination between all affected seawater users and project construction and environmental experts.

Marine Resources. The SEIS/R presents a detailed analysis of construction impacts on marine resources, including benthic organisms, crustaceans, anadromous fish, shellfish, and marine mammals. The SEIS/R identifies specific periods of peak fish migration and spawning, during which dredging work should be curtailed, which the FEIS/R did not do.

Groundwater. Both the SEIS/R and the FEIS/R address groundwater and water table impacts, stating that specific plans for dewatering and/or water injection will be developed during design. However, the SEIS/R presents a detailed outline of criteria, instrumentation, data collection, evaluation, and corrective actions involved in such a program.

Wetlands. The SEIS/R states that there will be unavoidable temporary impacts on some coastal and inland wetland resources due to construction activities. Following construction, disturbances will cease, banks will be restored, and disturbed wetlands will be replaced in the same location. The FEIS/R identified areas designated as wetlands under the Massachusetts Wetlands Protection Act and stated that the Boston Conservation Commission will impose construction methods to minimize wetlands impacts.

Terrestrial Ecology And Endangered Species. Neither document identifies any terrestrial ecology or endangered species impacts.

20.4.8 Aesthetic And Visual Impacts During Construction

The FEIS/R did not address visual and aesthetic impacts during construction. The SEIS/R identifies generic and site-specific impacts. It also describes appropriate mitigation measures for negative impacts.

20.4.9 Historic Resources And Archaeology

The historic resources inventory and project impact assessment are currently being reviewed by the MHC. When that consultation process is completed, the revised information will appear in this section and in Chapters 10 and 11. A contingency procedure is being developed for unanticipated archaeological resource discovery during construction.

20.4.10 Nuisance Abatement

Rodent Control. Both the SEIS/R and the FEIS/R identify rodent control programs. The FEIS/R outlined a two-phase program, including a mass extermination campaign prior to construction, and a maintenance extermination program in suspected habitat areas during construction. The SEIS/R contains a similar but more detailed program involving close coordination between project and City professionals and private citizens. The SEIS/R program will involve standard baiting and extermination techniques prior to and during construction. These measures will be complemented by a public education campaign and increased sanitation enforcement. The entire program will be managed by a team of highly qualified professionals who will follow strict guidelines and issue periodic progress reports.

Cockroach Mitigation. Cockroach mitigation measures were not discussed in the FEIS/R. The SEIS/R states that all buildings slated for demolition will be assessed for potential cockroach migration. If a migration problem is foreseen, appropriate extermination measures will be taken.

Odor Control. Both documents propose similar mitigation measures for odors caused by construction equipment exhaust and by dredge or excavate materials.

20.5 RESOLUTION OF ISSUES RAISED BY PUBLIC AGENCIES

Over 400 comments from 11 public agencies and interest groups were received on the construction impacts chapter of the Agency Review Draft. These comments were considered and are reflected in this SEIS/R. The major issues are summarized here along with a brief response.

20.5.1 Analysis Of Air Quality, Traffic, And Noise Impacts

Issue. The U.S. EPA has requested an analysis of the air quality, traffic, and noise impacts of the project's construction activities, in view of the long construction period and the large area and numbers of people to be affected.

Response. The 1985 FEIS/R did not include a detailed quantitative assessment of the air quality implications of traffic effects that could occur during construction of the Artery/Tunnel Project. It stated that an analysis of these effects would be completed during the design stage of the project, when definitive construction plans, detour routings, and traffic volume estimates have been developed. The Department hereby reaffirms its commitment to conduct air quality, traffic, and noise impact analyses as soon as possible based on an appropriate level of final design development including; (1) interim year(s) traffic data, (2) detours and diversions based on final design, and (3) the detailed information on construction phasing and sequencing required to make reasonable air quality assumptions at the subarea level. To that end the Air Quality Analysis Protocol has been revised to indicate that the analysis will be performed during the Section Design phase of the project. A procedure for conducting the assessment of detours where mitigation may be appropriate has been proposed and is included in the Maintenance of Traffic Plan Appendix to this SEIS/R. The Maintenance of Traffic Plan discloses the project's potential traffic impacts and suggests appropriate generic mitigation measures based on preliminary design which will be revised to reflect final design considerations.

20.5.2 Delayed Completion Of Seaport Access Road And Opening Of Third Harbor Tunnel

Issue. Traffic and air quality effects related to the delayed completion of the Seaport Access Road and opening of the Third Harbor Tunnel have not been addressed.

Response. A model of the construction traffic network currently is being developed and will be used to analyze these effects as part of continuing maintenance of traffic planning (see Maintenance of Traffic Appendix).

20.5.3 Maintenance Of Traffic

Issue. The systemwide maintenance of traffic discussion is vague and must contain reasonable assurances regarding model shifts, and the type and timing of mitigation actions.

Response. Model shift estimates for public transportation have been included in this document (see Section 3.3.2 of the SEIS/R, Public Transportation). Generic mitigation actions and measures have been identified in the Maintenance of Traffic Plan. The most appropriate and effective measures will be selected during final design, based on the availability of more detailed traffic and construction information, planning, and interaction with public agencies and local communities and abutters.

20.5.4 Conveyer System

Issue. A thorough discussion of all aspects of the conveyor system should be included in the SEIS/R.

Response. A conveyor system for transport of excavated material is generally described in the SEIS/R. This specialized technology currently is being considered for several areas of the project, but has not yet been included as part of the project. If adopted, it would be implemented as a mitigation measure, resulting in a substantial reduction in project-related trucks from City streets. Under one option, the barge loading facility on Fort Point Channel would be eliminated. However, other potential effects of the system are still being investigated prior to a decision.

20.5.5 Public Agency Participation

Issue. Several public agencies raised questions regarding their role and participation in the construction management process and continuing mitigation planning process, especially when these agencies will be involved in the implementation of mitigation measures.

Response. The Department has created a special Project Mitigation Program Office which will interface between construction management and public agencies, and coordinate the planning and implementation of mitigation measures. In addition, continued development of the Maintenance of Traffic Plan will be integrated with the activities of the Transportation and Construction Coordinating Committee (TRANSCCOM), a committee of representatives from 14 key City and State agencies.

The Department will work closely with the City of Boston and appropriate City agencies to develop the most effective construction mitigation program and maintenance of traffic plan possible. This relationship will entail direct participation in project activities, through the Project Mitigation Office, as well as open channels of communication with the Department's Project Director and Consultant Project Manager. A formal agreement between the City and the project regarding this relationship is being developed.

Agencies, Organizations, and Persons to Whom Copies of the SEIS/R Were Sent

LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM THE SEIS/R WAS SENT

The following Federal, State, regional, and local agencies, elected public officials, and other parties were sent copies of this SEIS/R. An asterisk (*) denotes transmittal of the SEIS Executive Summary only.

Federal Agencies:

- Advisory Council on Historic Preservation
- Army Corps of Engineers
- Coast Guard
- Department of Defense
- Department of Energy
- Department of Interior
    - Fish and Wildlife Service
    - Geological Survey
    - National Park Service
- Department of Transportation
    - Federal Aviation Administration
    - Federal Railroad Administration
    - Urban Mass Transportation Administration
- Environmental Protection Agency
- Federal Emergency Management Agency
- Federal Energy Regulatory Commission
- Federal Reserve Bank of Boston
- General Services Administration
- Health and Human Services
- Housing and Urban Development
- National Marine Fisheries Services
- Postal Service

State Agencies:

- Office of the Governor, Commonwealth of Massachusetts
- Economic Development Office
- Executive Office of Administration and Finance
    - Division of Capital Planning and Operations
- Executive Office of Communities and Development
- Executive Office of Economic Affairs
    - Office of Training and Employment Policy
    - State Office of Minority and Women Business Assistance
- Executive Office of Environmental Affairs
    - Coastal Zone Management Office
    - Department of Environmental Management

State Agencies (Cont.):

  - Department of Environmental Protection
  - Department of Fisheries, Wildlife and Environmental Enforcement
  - Division of Conservation Services
  - Massachusetts Environmental Policy Act Unit
  - Metropolitan District Commission
- Executive Office of Public Safety
- Executive Office of Transportation and Construction
  - Central Transportation Planning Staff
  - Massachusetts Aeronautics Commission
  - Massachusetts Bay Transportation Authority
  - Massachusetts Port Authority
  - Massachusetts Turnpike Authority
- Massachusetts Department of the State Auditor, Budget Director
- Massachusetts Division of Marine Fisheries
- Massachusetts Historical Commission
- Massachusetts Office of the Inspector General
- Massachusetts Water Resources Authority
- Metropolitan Area Planning Council

Local Agencies:

- Office of the Mayor, City of Boston
- Boston Business and Cultural Development Office
- Boston City Clerk
- Boston Conservation Commission
- Boston Economic Development and Industrial Corporation
- Boston Employment Commission
  - Office of Jobs and Community Services
- Boston Environment Department
- Boston Fire Department
- Boston Harbormaster
- Boston Health and Hospitals Department
- Boston Housing Authority
- Boston Inspectional Services Department
- Boston Landmarks Commission
- Boston Parks and Recreation Department
- Boston Police Department
- Boston Public Facilities Department
- Boston Public Works Department
- Boston Real Property Department
- Boston Redevelopment Authority
- Boston Transportation Department
- Boston Water and Sewer Commission
- Office of Capital Planning
- Office of Neighborhood Services
- Public Improvement Commission

Local Agencies (Cont.):

- Office of the Mayor, City of Cambridge
  - Cambridge community Development Department
  - Cambridge Public Works Department
- Cambridge Conservation Commission

The following elected public officials were sent copies of this SEIS/R. An asterick (*) denotes transmittal of the SEIS/R Executive Summary only.

Elected Public Officials:

Federal Legislators

- U.S. Senator Edward M. Kennedy
- U.S. Senator John F. Kerry
- U.S. Representative Chester Atkins
- U.S. Representative Silvio Conte
- U.S. Representative Brian Donnelly
- U.S. Representative Joseph Early
- U.S. Representative Barney Frank
- U.S. Representative Joseph P. Kennedy II
- U.S. Representative Edward J. Markey
- U.S. Representative Nicholas Mavroules
- U.S. Representative J. Joseph Moakley
- U.S. Representative Richard Neal
- U.S. Representative Gerry E. Studds

State Legislators

Senate

- Albano, Salvatore (Somerville)*
- Aleixo, Theodore J., Jr. (Taunton)*
- Amick, Carol (Bedford)*
- Barrett, Michael (Cambridge)
- Berry, Frederick E. (Peabody)*
- Bertonazzi, Louis P. (Milford)*
- Boverini, Walter (Lynn)*
- Brennan, John A., Jr. (Malden)*
- Buell, Robert C. (Boxford)*
- Bulger, William (Boston)
- Burke, John P. (Holyoke)*
- Cellucci, Argeo Paul (Hudson)*
- Costello, Nicholas J. (Amesbury)*
- Creedon, Michael (Brockton)*
- Doris, Francis (Revere)
- Golden, William B. (Weymouth)*
- Harold, Paul B. (Quincy)*
- Houston, John Patrick (Worcester)*
- Keating, William R. (Sharon)*
- Kirby, Edward P. (Whitman)*
- Kraus, Richard A. (Arlington)*
- Lees, Brian (Easthampton)*
- Lewis, Arthur Joseph, Jr. (Boston)
- Locke, David H. (Wellesley)*
- LoPresti, Michael (Boston)
- MacLean, William Q., Jr. (Fairhaven)*
- McGovern, Patricia (Lawrence)*
- Melconian, Linda J. (Springfield)*
- Norton, Thomas C. (Fall River)*
- Olver, John (Amherst)*
- Owens, Bill (Roxbury)
- Padula, Mary L. (Lunenburg)*

Senate (Cont.):

Pines, Lois G. (Newton)
Rauschenbach, Henri (Brewster)*
Sheehy, Paul J. (Lowell)*
Webber, Peter C. (Pittsfield)*
Wetmore, Robert D. (Barre)*
White, Thomas P. (Worcester)*
White, W. Paul (Dorchester)

House of Representatives:

Alexander, Francis F. (Beverly)*
Alexander, Lawrence R. (Marblehead)*
Ambler, Robert B. (Weymouth)*
Angelo, Steven (Saugus)*
Antonioni, Robert A. (Leominster)*
Bartley, John C. (Watertown)*
Beckwith, Geoffrey C. (Reading)*
Binienda, John J. (Worcester)*
Blanchette, Kevin P. (Lawrence)*
Blute, Peter I. (Shrewsbury)*
Bohigian, Robert J. (Worcester)*
Bosley, Daniel B. (N. Adams)*
Bourque, George J. (Fitchburg)*
Bradford, John C. (Rochester)*
Brett, James (Dorchester)
Brewer, Stephen M. (Barre)*
Buell, Carmen D. (Greenfield)*
Bump, Suzanne M. (Braintree)*
Burgess, Edward S., Jr. (Brockton)*
Businger, John A. (Brookline)
Cahir, Thomas S. (Bourne)*
Cahoon, Howard C., Jr. (Chatham)*
Caron, Paul E. (Springfield)*
Casey, Paul C. (Winchester)*
Catjakis, Athan (Springfield)*
Cerasoli, Robert A. (Quincy)*
Ciampa, Vincent (Somerville)
Clapprood, Marjorie A. (Sharon)*
Clark, Forrester A., Jr. (Hamilton)*
Cleven, Carol C. (Chelmsford)*
Cohen, David B. (Newton)
Collaro, Andrew (Worcester)*
Connolly, Joseph M. (Natick)*
Constantino, William, Jr. (Clinton)*
Correia, Robert (Fall River)*
Cox, John F. (Lowell)*
Decas, Charles N. (Wareham)*
DeFilippi, Walter A. (W. Springfield)*
DiMasi, Salvatore F. (Boston)
Doran, Stephen W. (Lexington)*
Driscoll, John R. (Northbridge)*
Durand, Robert A. (Marlborough)*
Emilio, Frank A. (Haverhill)*
Fiero, Patricia G. (Gloucester)*
Finneran, Thomas (Boston)
Fitzgerald, Kevin (Boston)
Flaherty, Charles (Cambridge)
Flaherty, Michael (Boston)
Flood, John H. (Canton)*
Flynn, William J., Jr. (Hanover)*
Forman, Peter (Plymouth)*
Fox, Gloria (Roxbury)
Galvin, William (Boston)
Gardner, Barbara (Holliston)*
George, John (Dartmouth)*
Gibson, Mary Jane (Belmont)*
Giglio, Anthony (Medford)
Giordano, Larry F. (Methuen)*
Glodis, William J. (Worcester)*
Grace, Augusto F. (Burlington)*
Gray, Barbara E. (Framingham)*
Guernsey, Sherwood (Williamstown)*
Harkins, Lida (Needham)*
Havern, Robert A. (Arlington)*
Hayes, Robert Emmet (Whitman)*
Healy, Jonathan L. (Charlemont)*
Hermann, Joseph N. (Andover)*
Herren, Albert (Fall River)*
Hicks, Lucille P. (Wayland)*
Hildt, Barbara (Amesbury)*
Hodgkins, Christopher J. (Lee)*
Holland, Iris K. (Longmeadow)*
Honan, Kevin (Brighton)
Hornblower, Augusta (Groton)*
Howarth, Robert L. (Springfield)*
Hynes, Frank M. (Marshfield)*
Jakubowicz, Robert Frank (Pittsfield)*
Jordan, Raymond, Jr. (Springfield)*
Karol, Stephen J. (Attleboro)
Kehoe, Marie-Louise (Dedham)*

House of Representatives (Cont.):

Kennedy, Thomas P. (Brockton)*
Keverian, George (Everett)
Koczera, Robert (New Bedford)*
Kollios, Paul (Millbury)*
Kraus, Robert (Kingston)*
Lambert, Edward (Fall River)*
Landers, Patrick F., III (Palmer)*
Lawrence, Dennis (New Bedford)*
LeLacheur, Edward A. (Lowell)*
Lemanski, Kenneth M. (Chicopee)*
Lewis, Jacqueline (Bridgewater)
Loring, John H. (Acton)*
Lozzi, Vicent J. (Lynn)*
MacGovern, John F. (Harvard)*
Mackey, Joseph K. (Somerville)*
Magnani, David P. (Framingham)*
Mandile, Anthony (Waltham)*
Mann, Charles W. (Hanson)*
Manning, M. Joseph (Milton)*
Mara, Francis G. (Brockton)*
Marsh, Robert H. (Wellesley)*
McDonough, John (Boston)
McGee, Thomas W. (Lynn)
McIntyre, Joseph (New Bedford)*
McKenna, Mary Jane (Holden)*
McNeil, John C. (Malden)*
Menard, Joan M. (Somerset)*
Merced, Nelson (Dorchester)
Miceli, James R. (Wilmington)*
Moore, Richard T. (Uxbridge)*
Morin, Peter B. (Barnstable)*
Morrissey, Michael W. (Quincy)*
Murray, Mary Jeanette (Cohasset)*
Myerson, Eleanor (Brookline)*
Nagle, William P., Jr. (Northampton)*
O'Brien, Shannon P. (Easthampton)*
O'Leary, Timothy F. (Melrose)*
O'Sullivan, Kevin (Worcester)*
Owens-Hicks, Shirley (Boston)
Pacheco, Marc (Taunton)*
Paleologos, Nicholas A. (Woburn)*
Palumbo, Thomas G. (Newbury)*
Parente, Marie J. (Milford)*
Petrolati, Thomas M. (Ludlow)*
Pierce, Steven D. (Westfield)*
Poirier, Kevin (N. Attleboro)*
Ranieri, Daniel J. (Bellingham)*
Rea, Michael J., Jr. (Billerica)*
Reinstein, William G. (Revere)*
Rohan, Robert J. (Holyoke)*
Roosevelt, Mark (Boston)
Rosenburg, Stanley C. (Amherst)*
Rourke, Susan F. (Lowell)*
Ruane, J. Michael (Salem)*
Rushing, Byron (Boston)
Saggese, Alfred E., Jr. (Winthrop)*
Scaccia, Angelo (Boston)
Schur, Susan D. (Newton)*
Scibelli, Anthony M. (Springfield)*
Serra, Emanuel Gus (Boston)
Suhoski, Chester A. (Gardner)*
Sullivan, Grepory W. (Norwood)*
Teague, Edward B., III (Yarmouth)*
Thompson, Alvin (Cambridge)
Tisei, Richard R. (Wakefield)*
Tobin, Arthur Stephen (Quincy)*
Torkildsen, Peter C. (Danvers)*
Travinski, Marilyn L. (Southbridge)*
Travis, Philip (Rehoboth)*
Trombley, Peter G. (Waltham)*
Tucker, Susan C. (Andover)*
Turkington, Eric (Falmouth)*
Vellucci, Peter A. (Cambridge)
Vernon, William B. (Mansfield)*
Voke, Richard (Chelsea)
Walrath, Patricia A. (Stow)
Walsh, Marian (West Roxbury)
Walsh, Michael P. (Agawam)*
Walsh, Thomas P. (Peabody)*
Woodward, Francis H. (Walpole)*

Local Elected Public Officials:

Boston City Councillors:

Bruce Bolling
James Byrne
Maura Hennigan-Casey
Thomas Menino
Albert O'Neil
Rosaria Salerno

Boston City Councillors (Cont.):

Christopher Iannella
James Kelly
Michael McCormack
Brian McLaughlin
David Scondras
Robert Travaglini
Charles Yancey

Cambridge City Councillors:

Edward Cyr
Francis Duehay
Jonathan Myers
Kenneth Reeves
Sheila Russell
Walter Sullivan
Timothy Toomey
William Walsh

Municipalities:

Arlington, Administrator*
Belmont, Administrator*
Beverly, Mayor*
Braintree, Administrator*
Brookline, Administrator*
Chelsea, Mayor*
Danvers, Administrator*
Dedham, Administrator*
Gloucester, Mayor*
Lexington, Administrator*
Lynn, Mayor
Malden, Mayor*
Manchester, Administrator*
Marblehead, Administrator*
Medford, Mayor*
Melrose, Mayor*
Milton, Administrator*
Nahant, Administrator*
Needham, Administrator*
Newton, Mayor*
Peabody, Mayor*
Quincy, Mayor*
Revere, Mayor
Salem, Mayor*
Saugus, Administrator*
Somerville, Mayor
Stoneham, Administrator*
Wakefield, Administrator*
Waltham, Mayor*
Watertown, Mayor*
Wellesley, Administrator*
Winchester, Administrator*
Winthrop, Mayor
Woburn, Mayor*

Libraries:

- Boston Public Libraries:
  - Main Library, 666 Boylston Street, Boston
  - Charlestown Branch, 179 Main Street, Charlestown
  - East Boston, 276 Meridian Street, East Boston
  - Kirstein, 20 City Hall Avenue
  - North End, 25 Parmenter Street
  - South Boston, 646 East Broadway
  - South End, 685 Tremont Street
  - West End, 151 Cambridge Street
- State House Library
- Transportation Building Library, 10 Park Plaza
- Boston Redevelopment Authority Library
- Cambridge Public Library, 449 Broadway Street
- Brookline Public Library, 361 Washington Street
- Massachusetts Institute of Technology, Roach Library

The following businesses, organizations, and individuals were sent copies of the SEIS/R. An asterick (*) denotes transmittal of the SEIS Executive Summary only.

A.D. Hilyer & Co.*
Aiello, Joseph and Mary
Airport Impact Relief (Air, Inc.)
Aleppo Shrine Yacht Club*
Allen, Demurgian, Major and Nitsch
American Automobile Association
American Bus Association*
American Lung Association Of Massachusetts
American Planning Association, Massachusetts Section
Anderson Associates
Andreson Nichols, Inc.*
Andrew Square Civic Association
Antique Yachting Etc.*
Arthur D. Little
Associated General Contractors*
Associated Industries of Massachusetts
Association for Public Transportation
ATEX, Inc.*
Atlantic Ave. Abutters Group
Bahne, Charles*
Barr, Mr. Theodore*
Bay State Steamship Company*
Beacon Companies
Beacon Hill Civic Association
Bennett Investment Properties*
Berger Associates
Berke, Mr. Steven*
Berman Co., The
BGS Systems, Inc.
Birmingham Properties*
Bolger, Mr. Michael*
Bolognese, Ms. Angela*
Boscom
Boston & Main Corporation
Boston Area Bicycle Coalition
Boston Aviation Council*
Boston Brotherhood of Taxi Drivers*
Boston Edison Company
Boston Educational Marine Exchange
Boston Flower Exchange, Inc.
Boston Freight Terminals*
Boston Gas Company
Boston Greenspace Alliance
Boston Harbor Associates
Boston Preservation Alliance
Boston Sand & Gravel
Boston Society of Architects
Boston Tea Party Ship & Museum
Boston Thermal Energy Corporation
Boston Typographical Union No. 13*
Boston Waterfront Neighborhood Assoc.
Boston Wharf Company
Boudreau, Perry
Braman Dow & Co.*
A.J. Bremen Realty Trust
Brooks, Mr. Arthur
Brown, Mr. and Mrs. Gary*
Brown Rudnick, Freed Gesmer
Cabot Cabot & Forbes Realty Advisors*
Camp International Holding, Inc.*
Campbell, Mr. Ken*
Cannata, Mr. Tony*
Capola, Mr. Joseph*
Carangelo, Mr. Ferdinand
Cargill Masterman & Culbert*
Caribou Fisheries
Carpenter-Carpenter*
Carpenters District Council of Boston*
Castle Metals Co./B.L.S. Inc.
Cecere, Mr. Anthony
Chardon Realty Trust
Charles River Park Association
Charles River Park "A" Company
Charles River Watershed Association
Charles T. Main*
Charlestown N.A.T.F.
Chase, Mr. Raymond*
Children's Museum
Childs Bertman Tseckares & Casendino
China Housing and Land Dev. Task Force*
Chinese Economic Development Council
Chinese Merchants Association
Christopher, Ms. Alice*
Ciampa Leasing Corporation
Cipriano, Ms. Theresa*
City Life Boston, Inc.
Coalition Against Third Harbor Tunnel*
Commercial Union Insurance Co.*
Communitas, Inc.
Community Information Center

Computer Museum
Congress Group Ventures Inc.
Conservation Law Foundation
Consilvio, Mr. Francis T.
Consolidated Rail Corporation (Conrail)
Construction Industries of Massachusetts*
Conte, Mr. Frank
Contos, N.J. and K.M.
Cooperative Corporation*
Corporate Legal Service
Cucchiara, Peter, Trustee
Curtis, Mr. Paul*
Cutler, Mr. Peter
D'Agostine, Mr. Edward J.
Damery, James A.*
D'Amico, Bob
Dave's Motor Transportation, Inc.*
David Dixon & Associates*
DeAngelis, Ms. Edith
Deluty, Mr. Michael*
DePaulo, Mr. Sonny*
Design-Science International*
DeStefano, Mr. Oscar*
DiCara Selig Sawyer & Holt*
DiLibero, Nick and Maria*
DiLorenzo, Mr. George*
Doherty, Mr. Joseph*
Donovan, Mr. Jim*
Downtown Crossing Association
D.S. Parking Trust*
Eagle Hill Civic Association*
East Boston Area Planning Action Council
East Boston Chamber of Commerce
East Boston Cummunity Development
East Boston Concerned Citizens Association*
East Boston Courthouse
East Boston Land Use Council
East Boston Neighborhood Health Center*
East Boston Savings Bank*
East Boston Social Centers
East Boston Sun-Transcript
East Boston Times - Free Press
East Boston Veterans Council*
Eastern Airlines*
Ecumenical Community Council*
Ellis Neighborhood Association*
Fahy, Mr. P. J.*
Falcone, Mr. Joseph F.*
Faneuil Hall Market Place
Fatles, Saul
Federal Reserve Bank of Boston
Feeney, Elizabeth M.*
Ferri, Mr. Mark*
Filoso, Mr. Andy*
Fine & Ambrogne
First Sterling Corporation*
Fishery Products, Inc.
Forgione, Mr. Martin*
Fort Hill Square Phase III Associates
Fort Point Arts Community
470 Atlantic Ave. Management Corp.*
Fraggos, Mr. Charles*
Fraser, Mr. Jim*
Frazier, Mr. Clark
Freilich, Mr. Joel*
Friedman & Atherton*
Friends of the Boston Harbor Islands
Frontage Development Corporation
Fruman, Sidney
Gannett Fleming Corddry & Carpenter
Gaston Snow & Ely Bartlett*
General Hospital Corporation
Geotechnical Engineers, Inc.
Giffee, Mr. Phil*
Gillette Company
Gioiosa, Ms. Josephine*
Giuliene, Mr. Louis*
Gnazzo, Jerold A.
Gladstone Associates*
Goldberg, Zoino & Associates, Inc.
Gore Street Citizens Committee*
Gray, Mr. John R.*
Gray, Mr. Justin
Great Northern FND
Great Northern Industry*
Greater Boston Chamber of Commerce
Greater Boston Community Development Corp.*
Greene, C.F.*
Grey Line, Inc.*
Grove Street Citizens Committee*
Grow Tunneling Corp.*
Hale and Dorr*
Halvorson Company*
Harbor Towers Condominium I
Harborside Community School
Hartman, Mr. Fredrick*

Haymarket Pushcart Association
Hinkle, Joseph
Historic Neighborhood Foundation*
HMM Associates*
Holy Redeemer Church*
Hotel Management & Development, Inc.
House of Bianchi, Inc.
Howry, Mr. Jeff
Hurst, Ms. Vicki*
Int. Union of Oper. Engrs. L.U. #4*
Ives, Mr. Jerry*
J.F. White Contracting Co.*
Jacobson, A&M, Trustee
James Hook & Company*
Jeffries Point Neighborhood Committee
Jets Club*
Johnson, Betsy
Jung, Brannen Associates Inc.*
Kehoe, Mr. Peter*
Kennedy & Son, Inc.
Kenney Development Co.*
Kennedy, Mr. Paul
Kramer, Mr. Bernard*
Kunlan, Mr. David*
Kuttner, Mr. Bill*
LaMattina, Mr. Sal*
Lane & Altman*
Langone, Mr. Fred
League of Women Voters Boston
League of Women Voters Waltham*
Leers, Weinzapfel Associates
Leonardi, Mr. Ron*
Lewis, Ms. Louise
Limbach Company*
Lisa Realty Trust
Loewenstein, Mr. Ernest*
Lombardo, Mr. Sal*
Macomber Development Company
Mader, Ms. Bernice*
Mahoney, Hawkes & Goldings
Manning, Mr. Paul W.*
Maramaldi, Ms. Diane*
Marchi, Ms. Diane*
Marchione, Mr. Nick*
Marullo & Barnes*
Massachusetts Audubon Society
Massachusetts General Hospital
Massachusetts Business Roundtable
Masterman, Edward, Esq.
Masterman, Mr. James
Maverick Tenants' Council
Mayor's North End/Waterfront Neighborhood Council
McCarter Hoffman, Ms. Cheryl*
McCourt Company
McGrath Sylva & Associates*
Megna, Mr. Bobby*
Meredith & Grew
Metro Toronto Roads & Traffic Department*
Miller, Ms. Gail*
Miller, Mr. Marvin*
Mintz Associates Architects/Planners, Inc.
Modica, Ms. Diane*
Morash, Ms. Evelyn*
Morgan, Mr. Jeff*
Morgan, Mr. Michael*
Moshe Safdie & Associates*
Moulison, Ms. Linda
Murphy, DeMarco & O'Neil, P.C.
Museum Wharf*
Mystic River Watershed Association*
National Car Rental System, Inc.*
National Railroad Passenger Corporation (Amtrak)
N.E.N.W.C.
New Boston Food Market
New Boston Garden Corporation
New England Council, Inc.
New England Legal Foundation
New England Seafood
New Jersey Dept. of Transportation*
New York State Office of Parks & Recreation*
N.O.A.H.
No Name Restaurant, Inc.
Norfolk Central Labor Council*
North Coast Seafood
North End Neighborhood Council
North End Nursing Home*
North Suburban Chamber of Commerce*
Northland Investment Company*
Noymer Manufacturing Company
Nucci, Mr. John
O'Connell, Ms. Sandra*
O'Donnell, Mr. Bernard*
Old North Church*
103 Allstate Trust

One Hundred Fifty (150) Trust*
Orient Heights Community Center
Orient Heights Improvement Organization
Orient Heights Neighborhood Organization
Orion Research Incorporated*
Orlandi, Mr. Roland*
O'Shea, Ms. Marie Mucci
Our Lady of Mount Carmel Church*
Our Lady of the Airway Chapel*
P & P Realty Company
Palladino, Ms. Elvira Pixie
Palma, Ms. Sue
Paris Street Gym
Park-N-Fly
Parsons, Brinckerhoff, Quade & Douglas
Paterson, Ms. Florence*
Paul Revere Memorial Association
Payette Associates*
Peltier, Mr. Louis*
Penn Central Transportation Co.
Peter Elliot & Company
Piers PAC*
Porgione, Mr. Martin*
Priestly, Ms. Jane*
ProFac Cooperative Inc.
Pugliano, Mr. Emilie
R.S.R. Realty Co., Inc.
Ramada Hotel
Rappaport & Raykov
Reliable Bus Lines, Inc.*
Riley, Fran*
Russia Wharf Company*
Robert E. Hannigan Associates
Robert F. Walsh Associates
Robie Properties*
Ruggerio, Rosemarie
Sacred Heart Church
Sarno, Mr. Joseph*
Sasaki Associates
Sax and Company
Scialabba, Ms. Joyce*
Scopa, Bobby
Sears Roebuck & Company
Shaeffer, K.H.*
Schiavone Construction Company*
Sierra Club
Simpson, Mr. William L.*
Skidmore, Owings, & Merrill
Slade Gorton & Company
Smith, Mr.Hallam J.
Smith, McNulty & Kearney
Society for the Preservation of New England Antiquities
Solomon Parking*
South Boston Citizens Association
South Boston Community Development Corp.
South Boston Information Center
South Boston Neighborhood House*
South Boston Residents Grop
South End Historical Society, Inc.
South End Transportation Committee
South Shore Chamber of Commerce*
Spaulding & Slye*
Spaulding, Mr. Josiah A.*
Spaulding Rehabilitation Hospital*
St. Cyr, Ms. Virginia*
Standex International Corporation*
Staropoli, Jean Denise*
State Street Corporation*
Stefano, Mr. Fred*
Steffano, Mr. Joseph*
Stone, Mr. Ken
Stone & Webster Engineering Corporation
Stop & Shop Companies, Inc.*
Stouffer, Ms.Caroline*
Straight, Ms. Susan*
Stryker, Ms. Lois*
Sullivan and Worcester*
Sullivan Group
S.V. Dixon Company
Sverdrup Parcel Corporation
Synergy Organization
Taft, Ms. Anna*
TAMS
Tapscott, Mr. Jim*
Tauro, Mr. Benny*
Taylor, Mr. Michael*
Tecce, Mr. Salvatore*
Teixeira, Ms. Maxine Tassinari*
Testa, Mr. Gene*
Thorne & Company*
Tirrell, Ms. Lillian*
Tolman Manufacturing & Supply*
Trainor, Ms. Maureen
Turner Fisheries
Two 40 Southampton Street, Inc.
United Bus Owners of America*

University of Massachusetts, Boston*
Urban Image Corporation*
Vanesse/Hangen
Vetter, Mr. Henri*
VFW-Order of the Sons of Italy*
Vierbickas, Mr. Gerard*
Vollmer Associates
Wang Industrial Laboratories, Inc.
Wardell, Mr. Joseph*
WCH Industries, Inc.*
Whittier Place Condominium
Widett, Slaber & Goldman, P.C.
Wilbur Smith Associates*
Wong, Ms. Ann*
World Trade Center
Zarrilli, Vincent F.
Zeytoonian, Mr. Ronald J.*
Zuccaro, John and Grace*

List of Preparers

LIST OF PREPARERS

This section briefly describes the responsibilities and backgrounds of the key individuals who were involved in the preparation or review of the SEIS/R for the Artery/Tunnel Project.

FEDERAL HIGHWAY ADMINISTRATION

Alexander Almeida
Project Manager, Artery/Tunnel Project

Mr. Almeida, a civil/highway engineer, is the principal FHWA representative for the Artery/Tunnel Project with overall responsibilities in the planning, design, and construction phases. He provided review assistance in the preparation of this document and coordination of comments from all FHWA offices. Mr. Almeida has 20 years of national experience in civil/highway engineering, design, development, and highway construction. He holds a Bachelor of Science degree in Civil Engineering from Southeastern Massachusetts University.

Gregory J. Doyle
I-90 Project Engineer, Artery/Tunnel Project

Mr. Doyle is responsible for FHWA coordination and review of all phases of work on the I-90 (Third Harbor Tunnel) segment of the Artery/Tunnel Project. In addition, he has held responsibility for the project value engineering program and in development of the SEIS for this project. His experience includes project development, engineering design, construction, and reviews of environmental documents for proposed highway projects. Accordingly, he has reviewed drafts of this document for consistency with Federal Highway environmental guidelines and regulations. Mr. Doyle holds a Bachelor of Science degree in Civil Engineering from Worcester Polytechnic Institute in Massachusetts.

Timothy A. White
I-93 Project Engineer, Artery/Tunnel Project

Mr. White is responsible for FHWA coordination and review of all phases of work on the I-93 (Central Artery) segment of the project. In addition, he has held responsibility for projectwide engineering elements and utilities relocation aspects of the project. His experience includes project development, engineering design, construction, and engineering reviews of environmental documents for proposed highway projects. He has reviewed drafts of this document for consistency with FHWA design criteria and environmental guidelines and regulations. Mr. White holds a Bachelor of Science degree in Civil Engineering from New Mexico State University.

MASSACHUSETTS EXECUTIVE OFFICE OF TRANSPORTATION AND CONSTRUCTION

Matthew A. Coogan
Undersecretary of Transportation

Mr. Coogan represented EOTC and provided extensive comments during the preparation of the Draft SEIS/R. In addition, he was responsible for the policy aspects of the project. Mr. Coogan specializes in transportation and community development at EOTC. Prior to serving at EOTC, he worked with the Boston Redevelopment Authority as a Senior Project Coordinator. He holds a B.A. in Social Psychology from Harvard College and was the recipient of a Loeb Fellowship in Advanced Environmental Sciences.

Anne P. Zebrowski
Special Chief Counsel, Artery/Tunnel Project

Ms. Zebrowski reviewed the Draft SEIS/R from a policy and legal perspective. She has served as legal counsel on numerous major capital construction projects in the Boston area, including the Orange Line Extension (Southwest Corridor) Project and the Red Line Extension Northwest. She also worked on the Braintree Station and Garage, the Quincy Adams Station and Garage, and numerous projects at Logan Airport and the Boston Seaport, including the World Trade Center and the Boston Fish Pier. Ms. Zebrowski is a graduate of Boston College Law School.

MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

William V. Twomey
Project Manager, Artery/Tunnel Project

Mr. Twomey manages the financial affairs of the $4.4 billion Artery/Tunnel Project and oversees the design and construction work of the State's management consultant for the project, Bechtel/Parsons Brinckerhoff. In addition, he coordinates the Department's efforts with the Federal Highway Administration and other State and Federal agencies. Mr. Twomey formerly directed the Department's Capital Expenditure Program Office and Administrative Services Department, and served as staff director of the Joint Transportation Committee of the Massachusetts State Legislature. He is a graduate of Boston University's School of Management and attended the University of New Hampshire.

Robert Albee
Deputy Project Manager and Manager of Engineering, Artery/Tunnel Project

Mr. Albee is responsible for right-of-way activity for the Artery/Tunnel Project, including the acquisition of land, the relocation of businesses, and the demolition of buildings. Mr. Albee also manages the relocation of utility structures in the project corridor before the start of construction. Mr. Albee previously worked for 23 years as a civil engineer for the

City of Boston's Public Works Department, where he was responsible for all highway and bridge design, planning and programming, and contracts and specifications. In 1986, he left the position of Chief Engineer to the Public Improvement Commission to join the Department's Artery/Tunnel Project team. Mr. Albee is a graduate of Lowell Technological Institute and is a member of the Board of Directors of the American Public Works Association.

Martha R. Bailey
Manager of Planning and Environment, Artery/Tunnel Project

Since 1986, Ms. Bailey has had overall responsibility for project planning, the preparation of the SEIS/R, and the community participation program. She previously served as a Senior Project Coordinator for the Boston Redevelopment Authority (BRA) for 6 years. Her major projects included Park Plaza, Columbia Point, and Parcel 18. Before joining the BRA, Ms. Bailey was the Chief of Planning for the City of Providence, Rhode Island. Ms. Bailey is a graduate of Radcliffe College; she also attended the University of Pennsylvania School of City Planning.

Leonard J. Barbieri, P.E.
Manager of Engineering, Artery/Tunnel Project (Former)

Mr. Barbieri has 30 years of experience evaluating and designing large-scale transportation engineering projects. He holds a Bachelor of Science degree in Industrial Technology from University College of Northern University. Mr. Barbieri was responsible for directing and coordinating all engineering aspects related to the Artery/Tunnel Project.

Rebecca Barnes
Manager for Urban Design and Facilities Planning, Artery/Tunnel Project

Ms. Barnes is an architect and urban designer whose principal areas of focus on this project were highway architecture, building architecture, and urban design. She was responsible for reviewing the Land Use and Visual Characteristics chapters and the Joint Development Appendix. Prior to joining the project staff, she was a Loeb Fellow at Harvard University's Graduate School of Design. Ms. Barnes received an A.B. in American Civilization from Brown University and a Master of Architecture degree from the University of Oregon.

Douglas E. Cotton
Manager of Environmental Procedures and Permits

Mr. Cotton had a major role in reviewing the SEIS/R with regard to environmental impacts, particularly water-related, and permitting requirements. He has over 10 years experience in water quality planning, waste disposal impact assessment, resource recovery facilities impacts, and pipeline and power plant impacts. He previously spent 5 years with ERT, Inc., a Concord, Massachusetts-based environmental consulting firm. Mr. Cotton holds a B.A. in Geography from the University of Massachusetts and an M.S. degree in Urban and Regional Planning from the University of Wisconsin.

Gloria A. Fry
Deputy Chief Counsel

Ms. Fry provided overview responsibilities for the SEIS/R and authored sections regarding drainage and hazardous waste impacts. She has 19 years experience in Massachusetts State government, including such fields as water pollution control, overall environmental protection, and hazardous waste cleanup. Ms. Fry has served as Senior Deputy General Counsel with the Massachusetts Department of Environmental Quality Engineering (now the Department of Environmental Protection). She holds an A.B. in Biology from Vermont College and a Juris Doctor degree from Suffolk University Law School, Boston.

Sergiu F. Luchian, P.E.
Projectwide Engineer, Artery/Tunnel Project

Mr. Luchian supervised and coordinated engineering aspects of the SEIS/R and is responsible for the development of the Supportive Engineering Report. Mr. Luchian previously worked for Bechtel Civil Inc., where he was responsible for the management of the SER and the Artery/Tunnel Project design criteria and concept reports. He has over 12 years of civil/structural engineering experience, including technical support for the project's 1985 FEIS/R, and is a graduate of the University of Bucharest, Romania.

CENTRAL TRANSPORTATION PLANNING STAFF

Thomas E. Lisco, Ph.D.
Manager of Artery/Tunnel Project Traffic Forecasting

Dr. Lisco was responsible for the development of traffic forecasting for various project scenarios and participated in the evaluation of queuing on the highway facilities. He has 20 years experience of travel demand analysis and transportation project evaluation. Dr. Lisco holds a B.S. in Mathematics and a Ph.D. in Economics from the University of Chicago.

BECHTEL/PARSONS BRINCKERHOFF, MANAGEMENT CONSULTANT

Donald W. Marshall, P.E.
Project Manager

Mr. Marshall oversees the design, construction, and environmental activities for the project. He has 20 years experience in construction management with the Bechtel Corporation, which includes participation in the Washington, D.C., Metro System, airport projects in Saudi Arabia, and other projects around the world. Mr. Marshall received his Bachelor of Science degree in Civil Engineering from Drexel University and is a member of the American Society of Civil Engineers and the Transportation Research Board.

Charles E. Carlson, P.E.
Director of Operations

Mr. Carlson supervised the preparation of the SEIS/R. He has 26 years experience in transportation, planning and environmental work. He served as Deputy Commissioner for Operations for the New York State Department of Transportation, which included responsibility for all environmental activities He also served as Director of Transportation for the Northeastern Region of New York State, supervising all engineering, planning, maintenance, and environmental work. Mr. Carlson served as Adjunct Professor of Public Administration at the State University of New York in Albany. Mr. Carlson received his B.C.E. from the City College of New York, did graduate work in Civil Engineering at the University of Wisconsin and in Management at Union College in Schenectady, NY, and New York State University in Albany.

Edward D. Hammond, P.E.
Environmental Services Manager

Mr. Hammond authored portions of the Materials Disposal chapter and coordinated its revision, and managed final preparation of the Draft SEIS/R. He has 19 years of experience in construction, construction management, and environmental and structural design and planning. Mr. Hammond received his B.S. degree from the United States Military Academy, and M.S. degrees in Civil Engineering and Economics from Massachusetts Institute of Technology.

Sigurd Grava, Ph.D., AICP
Quality Control Officer for the SEIS/R

Dr. Grava reviewed the SEIS/R for the Artery/Tunnel Project. He has 34 years experience in planning, including over 10 years experience on environmental impact statements for a wide variety of projects. He received his B.C.E. from the City College of New York, his M.S. in Planning from Columbia University, and his Ph.D. in Transportation Planning from Columbia University.

Beatrice Nessen
Environmental Permitting Supervisor and SEIS/R Interim Document Manager

Ms. Nessen was responsible for obtaining environmental permits for the Artery/Tunnel Project, including coordination with regulatory agencies. She managed the process required for the SEIS/R to be drafted, reviewed, and published, and wrote the sections on permitting. Ms. Nessen has 17 years experience in planning and environmental policy, including 10 years experience in sludge and solid waste policy and regulatory development for the Massachusetts Department of Environmental Protection. She received her B.A. from Wellesley College and her M.B.A. from Boston University.

Allan A. Hodges, AICP
Editor-in-Chief, SEIS/R

Mr. Hodges was responsible for reviewing the SEIS/R for compliance with applicable regulations, for consistency with commitments made by the Department of Public Works and the Federal Highway Administration in the FEIS/R, and for consistency with project design. He managed the preparation of the socioeconomic and land use sections of the report. He prepared the early drafts of the introduction and the project description and wrote the chapters on irreversible commitments of resources and short-term vs. long-term productivity, the Section 4(f) Evaluation on parklands and the initial draft of the alternatives analysis chapter in the Agency Review Draft. Mr. Hodges was the principal author of the South Boston Haul Road SEIS/R. In addition, he was responsible for incorporating all comments received on the Agency Review Draft into the SEIS/R. Mr. Hodges has over 23 years experience in project management and environmental impact preparation and permitting for transportation and development projects. He holds a B.Sc. in Community Development from the University of Southern Illinois and a Masters degree in Urban Planning from Michigan State University.

Alan Lubliner
Editor of Public Review Draft SEIS/R

Mr. Lubliner condensed the Agency Review Draft into the shorter and reorganized Draft SEIS/R. He also prepared the Summary. He has 19 years experience in planning, transportation, and environmental planning, including management of environmental impact statements for large public projects. Mr. Lubliner received his B.A. in Political Science from the University of Colorado and did graduate work at the University of California at Berkeley and Antioch College West.

David Atkin, Ph.D.
Environmental Engineer

Dr. Atkin managed the preparation of the water resources sections of the SEIS/R, including water quality, wetlands and waterways, vegetation and wildlife, floodplains, and materials disposal. He has 11 years experience in waterfront-related environmental projects. Dr. Atkin received a B.S. degree in Biology from Stanford University and a Ph.D. in Ecology and Evolution from Princeton University.

Chetlur G. Balachandran, Ph.D.
Noise and Vibration Specialist

Dr. Balachandran authored the chapters on noise and vibration for the SEIS/R. He has 30 years experience in acoustics, noise, and vibration on highway, transit, and rail projects and in architectural and engineering noise control in the United Kingdom, New Zealand, Canada, and the United States. Dr. Balachandran received his B.A., M.S., and Ph.D. in Acoustics from Madras University, India.

Ronald Bixby
Manager of Construction Impacts

Mr. Bixby, a Vice President of Parsons Brinckerhoff, had overall responsibility for the Construction Impacts section of the SEIS/R. He was also involved in the impacts during construction mitigation program and the maintenance of traffic plan. He has 17 years of experience in transportation planning and environmental assessment projects. Mr. Bixby received his B.A. from Notre Dame University and his Master of City Planning degree from the University of Pennsylvania.

Beth A. Bower
Archaeologist

Ms. Bower wrote sections on historic resources and archaeology for the SEIS/R based on surveys prepared for the Artery/Tunnel Project by Boston Affiliates, Inc., and the Boston University Office of Public Archaeology. Ms. Bower has 15 years experience in archaeology and holds a Master of Science degree in Anthropology from Brown University.

Joseph P. Carrara
Structural Engineer

Mr. Carrara served as manager of the Draft SEIS/R Supportive Engineering Report and assisted in preparation of structural engineering for the Area North of Causeway Street. He holds a Bachelor of Science degree in Civil Engineering from Northeastern University.

Mary E. Coffey, D.Sc.
Senior Air Quality Scientist

Dr. Coffey prepared the air quality and noise sections of the SEIS/R Agency Review Draft for the Artery/Tunnel Project and managed the monitoring of air quality and noise data. Dr. Coffey has 18 years experience in air quality. She holds a Doctor of Science degree in Environmental Health Science, Air Pollution Meteorology, Harvard University, School of Public Health.

Bruce A. Colvin, Ph.D.
Senior Scientist/Biologist

Dr. Colvin prepared the Rodent Control Program discussion for the SEIS/R. For the past 9 years, Dr. Colvin has worked with Dr. William B. Jackson, the leading international authority on urban rodent control. Dr. Colvin previously served as a consultant on rodent control and public education for the rodenticide industry, and conducted extensive research with the U.S. Fish and Wildlife Service on rodent control and safe use of rodenticide. Dr. Colvin holds a B.S. in Zoology from Ohio State University, a Master of Science degree in Biology from John Carroll University, and a Ph.D. in Biological Sciences from Bowling Green State University. He completed his doctorate and postdoctorate training in the Vertebrate Pest Program at BGSU.

Brenda Corbett
Editor/Proofreader

Ms. Corbett participated in editing and proofreading the SEIS/R and related documents, and prepared the glossary of terms. She has over 10 years experience in engineering and business writing and editing. Ms. Corbett holds a Bachelor of Arts degree from Boston University.

Michelle Gilleland Daigle
Structural Engineer

Ms. Daigle was manager of the Agency Review Draft Supportive Engineering Report and was responsible for coordination of technical design information and graphics for the SEIS/R, including coordination with Engineering. She has 4 years experience in structural design and construction. She has a B.S. in Civil Engineering from the University of Massachusetts at Amherst.

Stephen L. DeCandia
Creative Director

Mr. DeCandia was responsible for the design and execution of graphics as well as coordinating reproduction for SEIS/R and related documents. He has 17 years graphics design and production experience with Parsons Brinckerhoff.

David Druss, P.E.
Geotechnical Engineer

Mr. Druss managed the geotechnical work for the project, providing the geotechnical report for preliminary engineering. He has 13 years experience in heavy construction design and construction of transit system and highways. He has a Masters degree in Geotechnical Engineering from the University of Pittsburgh.

Rosemary F. Fraunces
Acquisition Supervisor

Ms. Fraunces has 8 years of experience in real property acquisition and property management. She supervised the preparation of parcel acquisition data for the SEIS/R and preparation of the Conceptual Relocation Appendix. She holds a B. A. degree from Rosemont College.

Peter Glover, P.E.
Projectwide Area Manager

Mr. Glover was responsible for preparing the Materials Disposal chapter of the SEIS/R . Mr. Glover has 22 years experience in heavy construction, civil engineering, and design. He holds a degree in Civil Engineering from University of Salford, England.

Dana L. Hansen
Director, Editorial Services

Mr. Hansen was responsible for coordinating the editing, word processing, and proofreading of the SEIS/R and related documents. He has over 25 years experience in planning and journalism. Mr. Hansen holds a Masters degree in Journalism and a Masters degree in Planning, both from Boston University.

Michael Henderson
Senior Economist (Former)

Mr. Henderson prepared the Ventilation Building Siting Report and the Disposal Site Screening Report for the Artery/Tunnel Project. He authored the section in the SEIS/R on materials disposal. Mr. Henderson has 11 years experience in alternatives analysis, demand forecasting, and economic impact analysis for transportation projects. He holds a B.S. from St. Louis University and an MBA from Columbia University.

Raymond J. Kingsley
Senior Economist (Former)

Mr. Kingsley coordinated the research and analyses of the subconsultants in estimating the economic impacts of the Artery/Tunnel Project. He has 20 years experience, primarily in planning and economic analysis for large projects. He has a Master of Science degree in Economics from the London School of Economics.

Melissa M. Laube
Senior Transportation Planner

Ms. Laube served as transportation coordinator for the SEIS/R and authored the transportation sections. She has 12 years experience in transportation systems analysis and planning. She holds an A.B. from Cornell University in Economics and a Master of City and Regional Planning degree from the Harvard Graduate School of Design.

Paik-Kee Low
Environmental Engineer

Ms. Low coordinated the preparation of the chapters on wetlands, floodplains, and vegetation and wildlife. She edited material developed by the ecological subcontractor, Jason M. Cortell and Associates, Inc., authored new material for the SEIS/R, and researched and wrote sections of various permit applications. Ms. Low has Bachelor of Science degrees in Mathematics and Electrical Engineering from Columbia University and a Master of Science degree in Electrical Engineering, also from Columbia University.

Owen MacDonald, P.E.
Senior Traffic Engineer

Mr. MacDonald managed preparation of technical traffic analysis for the SEIS/R and managed the traffic updates for project engineering and design. He served as traffic operations supervisor for the project. Mr. McDonald has 17 years experience in traffic engineering and transportation planning and holds a Master of Science degree in Civil Engineering from Northeastern University.

Warren McLea
Senior Utility Engineer

Mr. McLea was responsible for the design of utility relocations and the new drainage system, for the area from Kneeland Street through Charlestown. He prepared the utility sections of the SEIS/R. He has 27 years experience in highway-related design. Mr. McLea received his A.C.E. degree from Northeastern University.

Benjamin G. Perez
Assistant Planner

Mr. Perez conducted monitoring of existing noise conditions and prepared the energy impact analysis for the SEIS/R. Mr. Perez authored Chapter 12 (Utilities), prepared all sections on navigation impacts, coordinated the agency comment response procedures for the SEIS/R. He holds a Master of Science degree in Urban Planning from Columbia University, and a B.A. from Amherst College.

Thomas L. Sands, AICP
Supervising Environmental Planner

Mr. Sands directed the effort to incorporate agency comments into the portions of the SEIS/R dealing with biological and floodplain impacts. He assisted in preparation of the Materials Disposal chapter and was the principal author of the 404(b)(1) Appendix dealing with the discharge of dredge or fill material. This effort involved coordination with permitting agencies. Mr. Sands has 17 years of experience in environmental planning, alternative analysis, impact assessment, developing mitigation plans, and project management for a broad range of transportation and energy-related projects. He received an M.S. degree from the NYS College of Environmental Science and Forestry and a Masters Degree of Urban and Regional Planning from the University of New Orleans.

Guido G. Schattanek
Senior Environmental Engineer

Mr. Schattanek coordinated air quality analysis for the Artery/Tunnel Project. He has 11 years experience in engineering, environmental modeling, and the application of other analytical techniques for the environmental assessment of major capital projects. He received his B.S. and M.E.E. from Universidad Technologica Nacional, Argentina, and an M.E. degree in Environmental Engineering from Manhattan College, New York.

Esther Schwalb
Historic Resources Planner

Ms. Schwalb, a Senior Planner with Parsons Brinckerhoff, prepared the historic resources analysis sections and the Section 4(f) Evaluation regarding historic properties for the SEIS/R. Ms. Schwalb has 9 years experience in urban development and transportation projects, including historic resources, open space, parklands, land use and socioeconomic analysis. She received a B.A. from Barnard College and a Masters degree in Urban Design from Pratt Institute.

Erez Sela, P.E.
Supervising Water Resources and Environmental Engineer

Mr. Sela prepared the water quality chapter of the SEIS/R. His 16 years of experience includes supervision and preparation of numerous environmental studies related to the design and construction of large projects including highways, tunnels, viaducts, shopping centers, power plants, and reservoir and channel dredging. In addition, Mr. Sela has supervised and prepared water pollution control strategy studies and design of water, wastewater and effluent treatment, and stormwater management and flood control projects implemented as mitigation measures. He holds a Master of Science degree in Civil and Environmental Engineering from Polytechnic Institute of New York.

Keith S. Sibley, P.E.
Project Engineer, South Boston Haul Road

Mr. Sibley coordinated the efforts of the consultant team through the conceptual development and preliminary engineering phases of the Haul Road project. Mr. Sibley is a civil engineer with 16 years of experience and holds a Master of Engineering Degree in Construction Management from Rensselaer Polytechnical Institute.

Nassef Soliman, P.E.
Supervisory Geotechnical Engineer

Mr. Soliman was responsible for preparing the excavated soil characterization/soil quality reports and wrote the soils and geology section of the SEIS/R. He has a Bachelor of Science degree in Civil Engineering and a Masters degree in Soil Mechanics from Cairo University, and a Masters degree in Soil Dynamics from Brooklyn Polytechnical Institute.

Lizabeth Watson
Text Production

Ms. Watson was responsible for setting up guidelines and format for the SEIS/R document and for final quality control before printing. She holds a Bachelor of Arts degree from Allegheny College.

Robert Weiss
Project Engineer

Mr. Weiss assisted with the coordination of the transportation sections of the SEIS/R. He has a B.S. degree in Civil Engineering from City College and 30 years of experience in the transportation field.

KUDLICK ASSOCIATES, INC.

Walter Kudlick, P.E.
Agency Review Draft Report Manager, SEIS/R (Former)

Mr. Kudlick supervised the overall preparation of the Agency Review Draft of the SEIS/R. He is a civil engineer, transportation planner and traffic engineer with 37 years experience. This includes 15 years in environmental impact analyses and preparation of draft and final environmental documents for both highway and transit projects in accordance with procedures of the U.S. Department of Transportation's Federal Highway Administration and/or Urban Mass Transportation Administration.

WALLACE, FLOYD, ASSOCIATES INC.

Gordon Brigham
Public Participation Manager, Artery/Tunnel Project (Former)

Mr. Brigham managed planning and community participation components of the project. He has 23 years experience as a planner on a wide range of public and private projects. He has a B.A. in Architecture from Yale University and a Master of City Planning from MIT.

Wendy Landman
Planner

Ms. Landman assisted in the writing and editing of the Area North of Causeway Street and Materials Disposals sections of the SEIS/R. She holds a Masters degree in City Planning from M.I.T. and has worked on many EISs during her 11 years with Wallace, Floyd, Associates, Inc.

Deborah W. Poodry
Manager of Urban Planning and Community Affairs, Artery/Tunnel Project

Ms. Poodry was responsible for the coordination of community affairs for the Artery/Tunnel Project. She has 16 years experience in city planning, urban design, architectural programming, and project management. Ms. Poodry holds a Master of Architecture and Advanced Studies and a Master of City Planning, both from MIT.

James C. Purdy
Senior Planner

Mr. Purdy assisted in the writing and editing of the Section 4(f) Evaluation, and chapters on the Area North of Causeway Street, and Toll Plaza Alternatives. He assisted in preparation of the Section 4(f) Evaluation and other sections of the 1985 FEIS/R. He holds a Master of City Planning degree from M.I.T. and has worked on several transportation related plans and environmental impact documents during 13 years with Wallace, Floyd, Associates, Inc.

Lynn Sealey
Neighborhood/Community Facilities Section Manager

Ms. Sealey, a Senior Planner with WFA, prepared the neighborhood and community facilities section of the SEIS/R. She has 6 years experience as a planner on land use and environmental planning projects. Ms. Sealey holds a Masters degree in Urban and Environmental Policy from Tufts University.

Carole Schlessinger
WFA Project Coordinator

Ms. Schleslinger was responsible for the land use and visual impacts sections of the SEIS/R and the Joint Development and Conceptual Relocation Appendices. She has 9 years experience in planning. She holds a Masters degree in Community and Regional Planning from the University of Texas.

H. H. (Skip) Smallridge
Manager of Urban Design, Artery/Tunnel Project

Mr. Smallridge was responsible for design components of the project, including architecture, urban design, and landscape architecture. He assisted in preparing the Joint Development Appendix. He has 20 years experience as an architect and urban designer on a variety of projects for public and private clients. He has a degree in Architecture from the University of Virginia.

CAMBRIDGE SYSTEMATICS, INC.

Roanne Neuwirth
Assistant Economic Analysis Manager

Ms. Neuwirth, an Associate of CSI, assisted in preparation of the economic impact analysis for the Artery/Tunnel Project. She has worked on a wide range of economic development studies, transit and highway impacts studies, and real estate development. Ms. Neuwirth holds a Master in City Planning from MIT.

Thomas Rossi
Transportation Forecaster

Mr. Rossi prepared the transportation forecasting analysis for the project. He has 7 years experience in transportation modeling and planning analysis, and holds an M.S. degree in Transportation from MIT.

Earl Ruiter
Transportation Forecasting Manager

Mr. Ruiter, a principal of CSI, was responsible for transportation forecasting analysis for the Artery/Tunnel Project. He has 25 years experience in transportation demand forecasting analysis and holds a M.S. in Transportation from Northwestern University.

Glen Weisbrod
Economics Analysis Manager

Mr. Weisbrod, Vice President of CSI, managed preparation of the economic impact analysis for the Artery/Tunnel Project. He has 13 years experience in economic analysis and has directed economic impact studies of highways, airports, military bases, ports, and other facilities in many states. He has a Master of City Planning from MIT and a Master of Science in Civil Engineering/Transportation, also from MIT.

JASON M. CORTELL AND ASSOCIATES, INC.

Carlton Noyes
Vice President

Mr. Noyes prepared the water resources sections for the SEIS/R for the Artery/Tunnel Project. He has over 19 years experience in EIS preparation relative to transportation and development project impacts on water resources, wetlands, and sediments. Mr. Noyes holds a Master of Science degree in Zoology from the University of New Hampshire.

Amy H. Braiewa
Senior Ecologist

Ms. Braiewa prepared assessments and analyses of wetland-related sections, as well as terrestrial vegetation and wildlife discussions, for both the SEIS/R and Functions and Values Reports. She has 7 years experience in wetland delineation, assessment, and impact evaluation. Ms. Braiewa has a B.S. in Botany from the University of Michigan, and an M.S. in Botany/Wetland Ecology from the University of Rhode Island.

In addition, the following people were extensively involved in the administration, engineering, and environmental planning analysis of the Artery/Tunnel Project. Unless otherwise noted, they are, or were, staff of Bechtel/Parsons Brinckerhoff.

Management
Melvin J. Kohn, P.E. (Former)
Melvin Mirsky, P.E. (Former)

Agency Liaison
John Clements (Former)
Stacy Richards
Robert A. Snowber (Former)

Engineering
Richard Azzalina
S.G. Brisbin, Jr., P.E.
Jeff Brunetti, P.E.
Wayne Dix
Roger Fritz, P.E.
Bruno Garunkstis, P.E.
Walter Grantz, P.E.
Carol D. Hebb, P.E.

Engineering (Cont.)
Burt P. Kassap, P.E.
Tony Lancellotti, P.E.
William R. Mayer, P.E.
Arnold P. Moskowitz, P.E.
Michael Redfern, P.E.
Chan Rogers, P.E. (Former)
K.K. See-Tho, P.E.
Vinu Shah, P.E.
Louis G. Silano (Former)
Russell E. Tausch, P.E.
Jim A. Vears, P.E.
Ken Ware, P.E.
David Wen, P.E.

Traffic Projections and Analyses
Norman Chabot
John Hoffman
Steve Scalici, P.E.
Y. John Sun
Chris Wellander, P.E.
Chuck Whitmarsh

Environmental/Utilities
James Britt
James Brown
Robert Carleo, P.E.
John Coil, Ph.D. (Former)
Norman Danzinger, P.E.
Paul Domino
Walter Herrick, P.E.
Sam Less, AICP
Ted Prince
Joel Soden
Rae Zimmerman, Ph.D. (Former)

Planning/Design/Public Participation/Alternatives Analysis
Kitty Barkley
Susan Bleistift, Wallace, Floyd, Associates, Inc.
Peter G. Brigham, Wallace, Floyd, Associates, Inc.
David D. Davies, Carol Johnson Associates
Linda Jonash
David Wallace, Wallace, Floyd, Associates, Inc.

Administration
Frances Asano
Albert Payne, Scheduling

Graphics Design
Stephen Vande Water

Graphics Production
Ray Ciemny (Former)
Mary Gannett (Former)
Andy Giammarco (Former)
Kathleen Hepburn
Ted Hunter (Former)
Carla Morelli
Andrew Newelski (Former)
Richard Smith
Helen Walsh

Text Production
Tess Beck (Former)
Terence Donnelly
Philbert Herndon
Louise Lewis
Bob Nesti
Cathy Paven
Deb Walsh
Kenneth Ziegenfuss

Glossary

GLOSSARY

Above-grade construction: construction that takes place above the surface of the ground

Abutters: owners and/or managers and tenants of property adjacent to the project alignment

Acceleration/deceleration lane: an additional lane that gives sufficient space for entering vehicles to reach travelling speed before merging with through traffic, or for exiting vehicles to decelerate before reaching the exit ramp

Advection: horizontal and vertical flow of fluid, both water and air

Air rights: the right to use and control of a designated air space within the perimeter of a stated land area and within stated elevations: specifically, rights to develop structures or open spaces over the project tunnels

Alignment: a term used in the Artery/Tunnel Project to indicate the geographical location of roadways, ramps, tunnels, structures, etc.

Alternative 5A Modified: the Preferred Alternative in the 1985 FEIS/R; the present Proposed Action is a refinement of that plan, addressing all previously unresolved matters

Anadromous fish: adult ocean fish that migrate to spawn in fresh water

Aquaculture: cultivation of the natural produce of water (as fish or shellfish)

Archaeological finds: examples include bones, pottery, foundations of buildings and wharves, which can give us some knowledge of the daily life, architecture, and economics of the past; found below grade

Archaeological survey: for this project, a 3-phase process:

> **Phase I** - background research to identify sites including historical research, computer digitization of historic maps and utilities locations to pinpoint areas undisturbed by modern development; research design development; recommendations regarding potentially significant archaeological sites and their locations
>
> **Phase II** - remote sensing survey and field testing to identify sites which may be eligible for listing on the National Register of Historic Places
>
> **Phase III** - mitigation of potential adverse effects which may include full scale data recovery of the eligible archaeological site

Archaeology exhibit: planned for location near dig sites, to show archaeological finds unearthed and identified by project archaeologists

Argillite: a compact clayey rock

At-grade construction: construction that takes place on a level with the ground surface

Average Weekday Traffic (AWDT): the average traffic volume for an average 24-hour weekday period

A-weighted decibel (dBA): a measurement unit that adjusts measured sound pressure levels at different frequencies to conform to the frequency response of the human ear

Backfill: material such as sand, gravel, or crushed stone used to fill the space above the tunnel or between an excavation and the exterior of a structure or a trench

Bailey bridge: a bridge designed for rapid construction from interchangeable latticed steel panels that are coupled with steel pins; named for the engineer who developed it during World War II

Ballast: a stabilizing weight used for placing of immersed tube sections in subaqueous tunnel construction; water pumped into tanks inside tubes, and/or heavy stone or concrete placed on top, will provide the weight necessary to hold tubes down safely during and after the joining operation

Barge loading facility: one of four piers to be used to transport excavated materials out of, and backfill into, the project area; strategically located sites are: Charles River, Fort Point Channel/Boston Edison, Boston Marine Industrial Park in South Boston, and Bird Island Flats adjacent to Logan Airport

Bascule bridge: a type of drawbridge in which one end is counterbalanced by the other on the principle of the fulcrum and lever

Bedrock: Solid rock underlying unconsolidated surface materials, e.g., soil

Below-grade construction: construction that takes place below the surface of the ground

Bent: a frame-like structure, commonly steel or concrete, which supports an elevated roadway

Benthic community: organisms that live on or in the bottom of a body of water

Bentonite: an absorptive and colloidal clay

Bentonite mud: a suspension of bentonite in water, used for holding up the side of deep trenches excavated by machine; bentonite slurry is often used as a lubricant to reduce skin friction in pipepushing, or the sinking of a caisson

Bioassay/bioaccumulation testing: as used for ocean disposal programs may be characterized as testing of marine organisms to determine the toxicity of marine sediment and the potential to accumulate contaminants in their flesh

Biochemical Oxygen Demand (BOD): the oxygen used in meeting the metabolic needs of aerobic microorganisms in water (such as water polluted with sewage) - also called biological oxygen demand

Biota: the flora and fauna of a region

"Blitz" Program: a rodent control program to begin 60 to 90 days prior to start of project construction, developed and implemented by professional exterminators and covering the construction and adjacent areas

Blue Line: one of three rapid transit (heavy rail) lines operated in the Boston area by the MBTA

Boat section: an uncovered section of roadway or ramp that connects a surface level road with an underground or below-grade roadway

Boom: a temporary barrier across a stretch of water to hold back oil slicks, vessels, or swimmers; a floating boom consists of expanded polystyrene cylinders threaded together with a wire rope

Boom curtain: a device used to contain floating and suspended materials in water; it consists of a floating boom under which a curtain is suspended

Boring, bore, or drill hole: a hole, approximately 3 to 5 inches in diameter, drilled into the earth to study the soil and groundwater conditions

Borrow pit: an excavation where material has been dug for use as fill at another location

Box girder: a main support beam, which has a square shaped or trapezoidal cross section; can be cast concrete, steel, or wood

Braced cofferdam: a type of excavation support system which maintains a watertight chamber so that construction can take place under dry conditions after dewatering

Bridge pier: a supporting structure at the junction of connecting spans of a bridge

British thermal unit (Btu): the amount of energy necessary to raise 1 pound of water 1 degree Fahrenheit, at or near 39.2 degrees

Bulkhead: a retaining wall along a waterfront

Bulking of material: the increase in volume of soil materials as they are disturbed through excavation

Bulk sediment analysis: the chemical and physical analysis for characterization of sediment and soil

Caisson: an underground concrete column used as a foundation element to support vertical loads

Capping material: sediment or soils that are intentionally placed over more contaminated materials for the purpose of capping or sealing the lower materials

Casting basin: a temporary dry dock (also called a graving basin); one will be built on the east shore of Fort Point Channel at the tunnel alignment between the shoreline and A Street for fabrication of those immersed tube tunnel sections too wide for transport under Fort Point Channel bridges; upon completion of fabrication the basin will be flooded and sections floated into place

Catadromous fish: adult freshwater fish that migrate to the ocean to spawn

Cellular cofferdam: a type of excavation support system which uses a wall of circular cells or drums, filled with sand and gravel to hold back water and allow dry building conditions

Central Artery North Area (CANA) Project: the realignment and depressing of a portion of Route 1 in Charlestown, and reconnecting it with Interstate 93

Central Transportation Planning Staff (CTPS): the transportation planning unit serving the designated Metropolitan Planning Organization (MPO) for the Boston area; it is administered by the Metropolitan Area Planning Council, one of the six public agencies comprising the Boston MPO

Certificate of No Hazard: (Federal Aviation Administration) 14 CFR, Part 77 (form 761-910): flight obstruction determination -- can limit height of proposed structures and/or require marking, lighting, etc.

Chapter 21E: Massachusetts General Laws, DEP; hazardous waste procedure for site assessment

Chapter 91: Massachusetts General Laws, DEP; license to alter "tidelands of the Commonwealth," defined by original colonial shoreline; regulates activities in both coastal and inland areas including construction, dredging, and filling performed in tidelands, as well as in great ponds and certain rivers and streams

Clamshell dredge: an excavating machine with a bucket having 2 hinged jaws; used to prepare underwater trenches and channels

Class B Waters: fresh water that is to be suitable for contact recreation, and the protection and propagation of fish and other aquatic life and wildlife

Class SA Waters: marine water that is to be suitable for primary and secondary contact recreation, the protection and propagation of fish and other aquatic life and wildlife, and shellfish harvesting without restrictions

Class SB Waters: marine waters designated for the same uses as Class SA waters, except shellfishing is subject to restrictions and depurations

Class SC Waters: marine waters designated for use as a marine fishery and for secondary contract recreation

Clean Water Act:

1. Section 401 DEP: State certification indicates that DEP has reviewed the program and says it is consistent with the intent of the act and will not degrade the quality of the receiving water body below State standards (required in order to obtain 2 and 3)

2. Section 402 (EPA): National Pollution Discharge Elimination System (NPDES) outfall permit to discharge wastes to "waters of the United States"

3. Section 404 USACE: Department of the Army permit to place fill in "waters of the United States," including wetlands

Cofferdam: a temporary structure used to keep earth and water from entering an excavation so that work can be performed in dry conditions; see cellular or braced cofferdams

Collector-distributor: a limited-access highway paralleling the expressway, providing access to it

Colonization: the growth of freshwater and marine organisms onto or into a surface

Combined sewer (CS): a sewer system used for both wastewater and stormwater flows

Combined sewer overflow (CSO): a sewer system that conveys both stormwater runoff and sewage, and which overflows during storm events above the capacity of the system

Commutershed: the catchment area from which commuters flow into a city

Cover (fill): material, usually earth, used to raise a piece of land to a required level

Cross-lot bracing: temporary supports used in below-grade construction; in a trench excavation, it supports the earth by pinning the bracing from one side to another; a series of braces is installed at intervals sufficiently close to hold back the earth

Culvert: a below-ground pipe or tunnel

Cut: an open excavation for carrying a road, railway, pipeline, or canal below ground level in the open

Cut-and-cover: a method of tunnel construction which involves digging a trench, covering it with decking to allow vehicular and pedestrian movement above while continuing with construction below

Decibel (dB): a measure of sound level

Deck barge: a barge with a flat deck, allowing trucks and loaders to work on the deck surface

Decking: a cover, usually wood, concrete, or steel, over an excavated area which allows construction to continue below while providing a temporary surface for traffic and pedestrians above

Depositional environment: the type of water environment where sediments accumulate over time, as opposed to an environment where erosion takes place

Design year (2010): the future year for which traffic volumes projected are accommodated in the project design, such as number of traffic lanes

Dewatering: removing water, by pumping or other means, from an area to be excavated

Diffusion/dispersion: the expansion of a plume about its centerline due to turbulence and flow plus expansion of a plume to areas of lower concentration

Dredged material: material that is removed from below the mean high tide line in the waters of the United States

Drogue: a weighted device, usually attached to a buoy, used to measure currents

Drumlin: an elongate or oval hill of glacial drift; many of the islands in Boston Harbor are drumlins

Dry dock: a dock that can be kept dry for use during the construction or repairing of ships

Dump scow: a large, flat-bottomed barge with broad square ends used for transporting bulk material; the bottom of the dump scow can be opened to allow disposal of material

Dust control agent: water or other chemical sprayed on surface of road or soil to prevent/reduce suspension of particulate

Egress roadway: an exit

Elutriation: size classification of airborne or liquid-borne particles by their settlement speeds

Embayment: a bay or indentation along the shoreline

Entrainment: the drawing in and transporting (as of solid particles or gas) by the flow of a liquid

Environmental Impact Statement (EIS): a document detailing the probable impacts (environmental, sociological, economic, visual, etc.) of a proposed project in the planning phase

Equivalent Noise Level (L_{eq}): the equivalent steady noise level which in a given period of time contains the same noise energy as time-varying noise (i.e., environmental noise that fluctuates from moment to moment) during the same period

Excavated material: material removed from areas that are landward of the mean high water line

Extensometer: a device to measure the distance between two points in order to monitor movements caused by construction

Extraction Procedure Toxicity: one of the testing procedures for water soluble contaminants required by EPA and DEP to determine if a material should be considered hazardous; often referred to as "EP Toxicity test"

"Fast Track" Construction Program: scheduling that allows construction of early work to proceed while later work is still in the design phase

Fecal coliform bacteria: a group of bacteria, mostly of fecal or intestinal origin; used as a water quality criterion

Federal Consistency Concurrence: approval required to show that a proposed project is consistent with Massachusetts Coastal Zone Management Program regulations and policies

Federal Highway Administration (FHWA): an agency of the U.S. Department of Transportation responsible for setting and monitoring standards for highway construction, use, and impacts

Federal Highway Trust Fund: a fund financed by gasoline taxes to pay for highway construction and managed by the Federal Highway Administration; it will reimburse 90 percent of the cost of the Artery/Tunnel Project

Fetch: the distance traversed by waves without obstruction

Fifty-year storm: one generally of great severity expected, or recorded as occurring, about once every 50 years

Floodplain: (1) level land that may be submerged by floodwaters; (2) a stream built up by stream deposition

Flushing time: the time it takes for water flow (tidal and fresh) to replace the total volume of water in a given area

Fluvial deposits: sand and gravel deposited by streams

Footing: a foundation for a column, bridge pier, or wall

Footprint: the land area occupied by the ground floor of a structure

Foundation: the part of a building or structure which is in contact with the soil and transfers the weight of the building or structure to the ground

Gaussian curve (or normal curve): a type of frequency curve with a known equation; it fits a large number of those frequency distributions which most often occur

Geotextile: a fabric used as a curtain to protect, isolate, contain, filter, or segregate materials

Glacial till: unstratified glacial drift consisting of clay, sand, gravel, and boulders intermingled

Glacial till deposit: a poorly sorted deposit, formed by the breakup, transfer, and redeposition of material by glaciation; characteristic of glacial till are deposits with subangular particles of many differing minerals and rock types

Glacio-fluvial deposit: sand and gravel deposited by streams generated by glacier runoff

Glacio-marine deposit: formed from deposition by the glacier at the "ice-water" margin, where the glacier snout or ice shelf is afloat, or partly afloat, in lake or sea water; the deposit is formed mainly when the glacier base melts or breaks up, and the material is dropped or released into suspension

Grade: the degree of inclination of a road or a slope

Grade crossing: a crossing of highways, railroad tracks, or pedestrian walks, or combination of these on the same level

Great pond: a pond that in its natural state encompasses more than 10 acres of surface area

Green Line: MBTA light rail vehicle transit lines; all connect Lechmere at one end of the line with Brookline, Newton, Brighton, and Jamaica Plain at the other end via downtown Boston

Grid system: a network of horizontal and perpendicular roadways

Groundwater: water in the part of the ground that is wholly saturated

Gyre: a circular or spiral motion or form, especially a giant circular oceanic surface current

Habitat: the place or type of site where a plant or animal naturally or normally lives and grows

HABS: Historic American Building Survey, established in 1933 to document the nation's architectural resources

HAER: Historic American Engineering Record, established in 1969 to document the nation's engineering resources

Headway: the time interval between 2 vehicles travelling in the same direction on the same route

Hertz (H_z): a unit of frequency which corresponds to one cycle per second

High-occupancy vehicle (HOV): a vehicle, usually a bus or van, that carries more than one person

Highway Capacity Manual (HCM): Transportation Research Board Special Report 209, published in 1985; it sets forth the theory and application of traffic operations analysis, the established standards currently used in traffic engineering

Hourly equivalent noise level [L_{eq}(h)]: a measure of noise energy averaged over an hour, expressed in dBA

HOV lane: a highway lane reserved for HOVs

Hydraulic radius: the cross section of the water flowing through a channel divided by the wetted perimeter of the channel; the greatest hydraulic radius gives the largest flow for a given channel and slope

Hydrocarbon (HC): an organic compound containing only carbon and hydrogen, and often occurring in petroleum, natural gas, coal, and bitumens

I & M Program: an inspection and maintenance program requiring annual inspections of automobiles and light-duty trucks to determine if carbon monoxide (CO) and hydrocarbons (HC) amounts coming from their exhaust systems are below emission standards

Immersed tube: a method of tunnel construction which involves building tunnel sections on land, launching and towing them to site, and then lowering them into place below a harbor or waterway

Inclinometer: a device used to monitor horizontal displacements due to excavation or construction

Industrial Waste Disposal Site: a 1-mile diameter ocean site about 20 miles from Boston, which overlaps with the Massachusetts Bay Disposal Site, and where disposal of industrial wastes and dredged materials formerly took place; use of site has been discontinued

Injection well: a well used for artificial recharging of groundwater

Inner Harbor: Boston Harbor from the shoreline seaward to Governors Island and Castle Island

Inorganic silt: mud-free silt

Interagency Committee: City of Boston agency set up to monitor Artery/Tunnel Project, for exchange of information between City agencies and project staff, and to coordinate with other transportation studies and projects

Interagency Coordinating Committee: an organization established in October 1986 by the Massachusetts Department of Public Works to receive Artery/Tunnel Project information via monthly meetings; includes about 40 Federal, State, city, and other public agencies; also to obtain feedback from agencies to project staff

Interchange: a junction of two or more highways by a system of separate levels that permit traffic to pass from one to another without the crossing of traffic streams

Intertidal zone: the part of the littoral zone above low tide mark, or area between high and low tide

Invert concrete slab: the lower portion of a tunnel structure that supports the walls and top; when covered with asphalt, it is the part that vehicles drive on

Jacking technique: a method of installing pipe without using open cut construction; piping is pushed through the soil; when the soil is removed from the piping, additional pipe segments are advanced; this process is repeated until the necessary length of pipe is installed

Jersey barrier: protective boundary or roadway divider made of concrete

Joint Development Design Guidelines: Design guidelines to be developed through the joint development process which will ensure that future development of joint development parcels throughout the project area will be compatible with adjacent uses and historic districts, and consistent with the goals of the City, the Department, the community, and other interested parties

Joule: the absolute meter-kilogram-second unit of energy equal to approximately 0.7375 foot-pounds

Lagging: horizontal planking placed against the walls in a trench or tunnel to prevent the earth from entering the excavation site

Lay barge: a placing barge, used in the placement of immersed tube tunnel segments; the barge straddles the floating tunnel tubes and lowers them to the Harbor bottom

Leachate: water that has dissolved materials in it; often applied to contaminated water that has flowed from refuse sites

Level Of Service (LOS): a measure of the quality of traffic flow, ranging from A to F, where A is free-flowing traffic with little or no delay and F is slow-moving traffic with delays

Link span: a pontoon-supported ramp for use in loading or unloading barges

Load bearing walls: supporting walls, capable of bearing the weight of a building or structure above

Macroinvertebrate: larger, more visible organisms that inhabit the bottom of water bodies, or other surfaces (sponges, worms, crabs, shellfish, starfish, etc.)

Mainline tunnel: a tunnel carrying the principal roadway

Maintenance of Traffic Plan (MTP): coordination of traffic and transportation issues and mitigation measures to maintain accessibility to downtown Boston and minimize disruption to transportation and to businesses in the project area during each stage of construction

Marine disposal: discarding of materials at sea

Marine Resources Protection and Sanctuaries Act: Section 103, Corps of Engineers: permit for transporting dredged material out of U.S. waters for open ocean disposal

Massachusetts Bay Disposal Site (MBDS): an ocean disposal site about 20 miles east of the project site, presently designated by EPA to take only materials dredged from navigable water

Mean tidal prism (mtp): water volume between mean low and mean high tide

Memorandum of Agreement (MOA): under Section 106 of the National Historic Preservation Act of 1966, the product of consulting agency officials and/or others that contains stipulation specifying project avoidance or mitigation of adverse effects or accepting such effects; specifically the April 11, 1984 MOA for the Artery/Tunnel Project signed by FHWA, the Massachusetts State Historic Preservation Officer, and the Advisory Council on Historic Preservation, the Boston Landmarks Commission, and the Massachusetts Department of Public Works

Micrograms per cubic meter (ug/m^3): a unit for expressing the concentration of a pollutant in the atmosphere

Micron (um): a unit of length equal to one millionth of a meter; also called micrometer

Mitigation: planning of design and/or construction to overcome or avoid adverse impacts

Mobile source emission: motor vehicles are the principal source of carbon monoxide (CO); CO emissions increase with a decrease in vehicle speed, so traffic detours and delays could result in elevated concentrations of CO

Mollusk: invertebrate animal with a soft unsegmented, bilaterally symmetrical body and having tissue (mantle) which may secrete a calcereous shell; as with snails and clams

M_2 tide: a semidiurnal tide

National Historic Preservation Act: Section 106, Department of Interior: regulates Federal work that may impact historic resources; local conditions established via Memorandum of Agreement among four agencies

National Register (NR): National Register of Historic Places, the official list of the Nation's cultural resources worthy of preservation

Native sediment: till, clay, sand, and gravel that was deposited by a natural process and not human activities

Nautical miles (NMI): any of various units of distance used for sea and air navigation; U.S. and international: 6,076.115 feet (1,852 meters)

Oblique retractile bridge: a bridge on which the draw span moves to the side at an oblique angle

Offset distance: the distance (usually measured in feet) right or left of a centerline

Ohm: the practical meter-kilogram-second (mks) unit of electric resistance equal to the resistance of a circuit in which a potential difference of 1 volt produces a current of 1 ampere

One-hundred year floodplain: the limit of flooding that takes place during a 100-year storm event

Open cut: a method of excavation in which the work area is open at the surface (used to distinguish from cut-and-cover or tunneling work)

Orange Line: an MBTA rapid transit line between Forest Hills and Oak Grove

Organic silt: a silt or clay containing plant remains, occasionally animal remains; it has a very low bearing capacity, being highly compressible

Outer Harbor: that part of Boston Harbor which begins at Governors Island (next to Logan Airport) and extends seaward to Broad Sound

Outfall: the mouth of a drain or sewer

Ozone (O_3): a highly reactive form of oxygen that is formed in the lower atmosphere through photochemical reactions and, at sufficiently high levels, can be injurious to human health and the general welfare

Parcel 7: a site in the Haymarket area of Boston, presently a parking lot, on which a multi-use building will be constructed to house a 300- to 400-space garage, ventilation facility, and ground floor market

pH: the negative logarithm of the effective hydrogen-ion concentration in gram equivalents per liter; the scale of values being 0 to 14, with 7 representing neutrality, numbers from 7 to 1 show increasing acidity, and numbers from 7 to 14 show increasing alkalinity

Piezometer: an instrument used to measure water level pressure through subsurface strata; it monitors the effects of dewatering to avoid negative impacts on adjacent foundations

Pile: an underground column of wood, steel, or concrete driven or jacked into the ground or placed in drilled holes to support a load for a structure

Pleistocene glaciation: the Pleistocene epoch started about 2 million years before present; and the Pleistocene glaciation ended with the retreat of the Wisconsin glaciation, about 10,000 years ago

PM_{10}: particulate matter smaller than 10 microns in size

Polychaete worms: annelid segmented worms, chiefly marine, usually with paired segmental appendages and a free-swimming larva

Polychlorinated biphenyl (PCB): any of several compounds that are produced by replacing hydrogen atoms in biphenyl with chlorine, have various industrial applications, and are poisonous environmental pollutants which tend to accumulate in animal tissue

Portal: the opening at either end of a tunnel

Portal crane: a special type of crane used to load or unload boats in a port

Post-tensioned concrete: concrete which is stressed to improve its strength after having hardened

Precast concrete: concrete that is cast and cured in other than its final position

Precursor pollutants: pollutants such as HC and NO_x which are emitted directly by motor vehicles; they then participate in chemical reactions in the atmosphere from which ozone (a "secondary pollutant") is formed

Primary Corridor: the historic resources inventory study area for potential construction period and long-term impacts

Priority pollutant: a term used to classify some hazardous materials

Project Conservator: Architect/Engineer team appointed by the Department by stipulation in the Section 106 MOA; responsibilities include evaluation of historic structure conditions, review of design and construction plans and specifications to mitigate construction period effects to historic structures, and monitoring of mitigation programs for historic resources

Proposed Action: the Central Artery (I-93)/Third Harbor Tunnel (I-90) Project, a design refinement of the Preferred Alternative in the 1985 FEIS/R

Queue: a line of waiting vehicles

Rebar: steel bars placed within a concrete structure to strengthen the concrete

Receptor: an air quality analysis site for predicting ambient air levels of pollutants; also a location that receives noise from traffic

Red Line: MBTA line, running from Alewife in Cambridge to Ashmont in Dorchester, with a branch from Andrew Square to Braintree; underground in Boston and Cambridge, primarily on raised track beyond Andrew Square; connects with commuter rail at South Station; and runs under Fort Point Channel via a twin-tube tunnel

Resident engineer: one serving in a regular or full-time capacity for a project

Resource Conservation Recovery Act (RCRA): under this act, facilities are licensed for disposal of soils contaminated with PCBs

Revetment: a stone or concrete facing to sustain an embankment

Right-of-way: the land over or under which a road, utility, or other public line passes

Riprap: a layer of stones, pieces of concrete, or similar material placed on an embankment slope to prevent erosion

Riverine: relating to, formed by, or resembling a river

Rivers & Harbors Act of 1899 ("Refuse Act"): (1) Section 10, Department of the Army Permit (Corps of Engineers): permit for activities or work in "navigable water"; (2) Section 9, Bridge Permit (U.S. Coast Guard): permit for placing permanent structures in or over navigable water

Road grade: degree of inclination

RoRo Loading Facility: Roll-on/Roll-off ferry system using vehicles

Rowes Wharf: a hotel, office, and condominium complex on Atlantic Avenue in downtown Boston, also the site of a terminal for commuter boats and ferry service to Logan Airport, with mooring and marina basin

Saltmarsh: flat land subject to overflow by salt water and inhabited by species predisposed to inundation

Scour: the eroding action caused by a current of water

Screed barge: a barge equipped with a leveling device to lay a gravel foundation mat underwater prior to placement of tunnel sections

Seaport Access Road: I-90, new route which will connect the Third Harbor Tunnel with the I-93/I-90 Interchange

Seawall: a wall or embankment to protect the shore from erosion or to act as a breakwater

Secondary pollutant: a pollutant, such as ozone, formed by chemical reactions in the atmosphere (see definition of "precursor pollutants")

Section 4(f) Evaluation: Surface Transportation Act of 1966: prohibits use of parkland and historic or archaeological resources for Federal highways unless there is no "feasible or prudent alternative"

Sediment plume: a concentration of sediment suspended in the water during construction

Semidiurnal tides: tides occurring every half-day

Sheet piling: steel underpinning for tunnel support interlocking steel panels driven into the ground to provide excavation support for construction or underground facilities

Sight shelves: space to the left or right side of a roadway, usually at a curve, that improves visibility for motorists

Silt: granular material finer than sand but coarser than clay

Silt curtain: a curtain made of special fabric lowered into a waterway to prevent silt from moving out of the construction area

Slurry: a watery mixture of insoluble matter, such as bentonite

Slurry wall construction: a method of constructing an underground support wall or a tunnel wall from the surface; reinforced concrete walls are constructed in a trench held open initially by a mixture of clay and water, called bentonite slurry, allowing excavation to continue to the desired depth; then excavation reinforcing is placed in the slurry and concrete is placed by the tremie method

Snorkel tube: a tube housing air intake and exhaust pipes that protrudes above the water surface for supporting submerged tunnel segments

Soil loading: a force generated by the weight of soil

Soldier piles: a method of constructing an excavation support system using steel piles spaced along the perimeter of the excavation; between these, horizontal planking (lagging) is placed to create a retaining wall as the earth is removed

South Boston Bypass Road: a limited-access roadway between I-93 and I-90 for the exclusive use of trucks and buses, an extension of the South Boston Haul Road

South Boston Haul Road: a limited-access roadway between Dorchester Avenue and Congress Street to be built as an advance construction traffic mitigation measure for the Artery/Tunnel Project, for the use of trucks

Storm drain: a sewer or pipe through which stormwater is conveyed

Subaqueous disposal site: an underwater location, environmentally approved, used for depositing excavated or dredged materials

Sub-base: a bed of material laid under a road base on the natural ground to strengthen it, to improve the drainage, or for some other purpose

Substrate: the base on which an organism lives

Successional area: a site characterized by unidirectional change in the composition of an ecosystem as organisms and especially plants respond to and modify the environment

Supervisory Control and Data Acquisition (SCADA): a data system composed of factors that will require remote monitoring or controlling, data to be transmitted, and the center where all data will be monitored or processed

Surcharge load: additional surface loading above and beyond the base load which needs to be considered for design

Surfactant: a surface-active substance (soap is a surfactant)

The Department: Massachusetts Department of Public Works, the proponent of the Artery/Tunnel Project

Third Harbor Tunnel: a tunnel to be constructed under Boston Inner Harbor between South and East Boston to relieve traffic congestion in Callahan and Sumner Tunnels and on the Mystic-Tobin Bridge

Tidal excursion: the distance a particle of water will travel on an ebb or flood tide

Tidegate: an underwater structure for controlling the flow of water

Tideland: land overflowed during flood tide; historic tidelands are filled or flowed water areas seaward of the original Colonial shoreline of Boston

Tieback: an anchoring device composed of a cable or steel rod embedded in grout to act as an earth retention system during construction

Tombolo: a sand or gravel bar connecting an island with the mainland or another island

Tracer concentration: injection of a trace substance in marine waters to monitor the efficiency of harbor flushing in removing pollutants

Traffic and Emergency Control Center (TECC): operations center for the City of Boston's computerized traffic signal monitoring and control program

Traffic Relief Program (TRP): program instituted by the City of Boston to improve traffic flow through removal of on-street parking and other traffic management measures

Transverse grade beam: a horizontal load bearing structural member that spans excavation support walls and is used to support overhead structures

Trapezoidal cut: an excavation whose cross-section is in the shape of a trapezoid, with the wide side above the narrow side

Tremie concrete: concrete that is placed underwater by being pumped through a tremie tube; when the concrete reaches its destination, the tube is slowly pulled out, with the concrete flowing in the water until the desired amount is placed

Turbidity: a measure of the clarity of water

Underpinning: a permanent or temporary support system to provide strength and reinforcement to a building or structure to prevent any settlement caused by adjacent construction

V/C Ratio (Traffic Volume-to-Capacity Ratio): a measure comparing actual vehicle traffic volumes to roadway capacity, used as an indicator of traffic operating conditions

Vehicle Loop Detectors: sensors embedded in roadway pavement and amplifiers to monitor and count vehicle traffic volumes and speeds; a component of the traffic surveillance and control system

Ventilation building: a facility constructed to accommodate the mechanical and electric equipment necessary to ventilate, power, and light the tunnel structures

Viaduct: a bridge carrying a roadway over an obstruction, such as a river or another section of highway, or connecting a surface road with an elevated roadway

Volatile halogenated compounds (VHOC): chlorinated organic compounds which have a lower molecular weight and disperse readily into the environment

Volatile organics: a collective term used to describe all the lower molecular weight organic compounds which disperse readily into the environment

Waterplane: the surface area of a body of water

Weave: a traffic movement that results when vehicles entering the roadway cross the paths of vehicles exiting the roadway

Wetlands: those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted to life in saturated soil conditions

Wetlands Protection Act (Massachusetts): Order of Conditions [Boston Conservation Commission/DEP]: sets out conditions for work "affecting wetlands" -- unique and broad definition of wetlands

Wye Connector: a single track Amtrak freight line to be relocated slightly south of its original location, to begin south of I-90 at Albany Street and extend southeasterly to rejoin the track south of the Broadway bridge

Year 1: the start of project construction

Abbreviations

LIST OF ABBREVIATIONS

AASHTO	American Association of State Highway Transportation Officials
AAQS	Ambient Air Quality Standards (State and Federal)
ACEC	Areas of Critical Environmental Concern
acfm	Average cubic feet/minute
ADT	Average daily traffic
A/E	Architectural/Engineering
API	American Petroleum Institute
APR	Areas for Preservation or Restoration
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
AWDT	Average weekday traffic
bbl	Barrel
BFD	Boston Fire Department
BIF	Bird Island Flats
BISD	Boston Inspectional Services Department
BLC	Boston Landmarks Commission
BMIP	Boston Marine Industrial Park
BOD	Biochemical oxygen demand
BPFD	Boston Public Facilities Department
BPRD	Boston Parks and Recreation Department
BRA	Boston Redevelopment Authority
BTD	Boston Transportation Department
Btu	British thermal unit
BWSC	Boston Water and Sewer Commission
CADD	Computer-Aided Design and Drafting System

CANA	Central Artery/North Area Project
CBD	Central Business District
CCTV	Closed circuit television
CD	Combined drain
cfm	Cubic feet per minute
cfs	Cubic feet per second
CHART	Cross Harbor and Regional Transportation Project (by Massport)
CMSA	Consolidated Metropolitan Statistical Area
CO	Carbon monoxide
CS	Combined sewer
CSO	Combined sewer overflow
CTPS	Central Transportation Planning Staff
CV	Commercial vehicle
DAQ	Division of Air Quality (State)
dB	Decibel
dBA	A-weighted decibel
DCPO	Division of Capital Planning and Operations
DEM	Department of Environmental Management (State)
DEP	Department of Environmental Protection (State - formerly DEQE: Department of Environmental Quality Engineering)
DMF	Division of Marine Fisheries (State)
DO	Dissolved oxygen
DOE	Determination of Eligibility
DOT	Department of Transportation (Federal)
DPA	Designated Port Area (State)

DSW	Division of Solid Waste (State)
DWPC	Division of Water Pollution Control (State)
DWWR	Division of Wetlands and Waterways Regulation (State)
EB	Eastbound
EDIC	Economic Development and Industrial Corporation (City)
EIS/R	Environmental Impact Statement/Report
e max	Maximum rate of superelevation
EOEA	Executive Office of Environmental Affairs (State)
EOTC	Executive Office of Transportation And Construction (State)
EPA	Environmental Protection Agency (Federal)
FCMS	Final Construction/Mitigation Scheme
FEIS/R	Final Environmental Impact Statement/Report
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FPC	Fort Point Channel
fps	Feet per second
FRA	Federal Railway Administration
GEP	Good Engineering Practice
gpm	Gallons per minute
HC	Hydrocarbon
HCM	Highway Capacity Manual
HOV	High-occupancy vehicle
HS	High service water line
HVAC	Heating, ventilation and air conditioning
H_z	Hertz

in/sec	Inches per second
IPOD	Interim Planning Overlay District (Boston Redevelopment Authority)
kv	Kilovolt
L_{eq}	Equivalent noise level
$L_{eq}(h)$	Hourly noise level equivalent
L_{90}	Residual, or "ambient" noise level
LOS	Level of Service
LS	Low service water line
MAPC	Metropolitan Area Planning Council
MBDS	Massachusetts Bay Disposal Site
MBTA	Massachusetts Bay Transportation Authority
mcf	Thousand cubic feet
MCP	Massachusetts Contingency Plan
MCZM	Massachusetts Coastal Zone Management
MDC	Metropolitan District Commission
MDP	Materials Disposal Program
MDPW	Massachusetts Department of Public Works
MEPA	Massachusetts Environmental Policy Act
mgd	Millions of gallons per day
mg/l	Milligrams per liter
mg/m^3	Milligrams per cubic meter
MGLB	Massachusetts Government Land Bank
MHC	Massachusetts Historical Commission (see SHPO)
MHR	Massport Haul Road
MHW	Mean high water

MLW	Mean low water
MMCF	Million cubic feet
MOA	Memorandum of Agreement
MPA	Massachusetts Port Authority (Massport)
MPN	Most probable number
MPO	Metropolitan Planning Organization
MPRSA	Marine Protection Research and Sanctuaries Act
m/s	Meters per second (more commonly used than m/sec)
m/sec	Meters per second
MSL	Mean sea level
MSRC	Marine Services Research Center
MTA	Massachusetts Turnpike Authority
MTP	Maintenance of Traffic Plan (see PMP)
mtp	Mean tidal prism
MWL	Mean water level
MWRA	Massachusetts Water Resources Authority
NAC	Noise Abatement Criteria
NB	Northbound
NECMA	New England County Metropolitan Area
NEDUSACE	New England Division, U.S. Army Corps of Engineers
NEPA	National Environmental Policy Act
NESI	New East Side Interceptor
NHL	National historic landmark
NHPA	National Historic Preservation Act
NMHC	Non-methane hydrocarbon

NMI	Nautical mile
NO	Nitric oxide
NO_x	Nitrogen oxide
NO_2	Nitrogen dioxide
NOAA	National Oceanographic and Atmospheric Agency
NPC	Notice of Project Change
NPDES	National Pollution Discharge Elimination System
NR	National Register (of Historic Places)
NRE	National Register Eligible
NTU	Nephelitic turbidity unit
O_3	Ozone
OEMDS	Ocean Excavated Materials Disposal Site
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
pcc	Platinum cobalt color
PCPH	Passenger/cars/per hour
PFD	Public Facilities Department [(see BPFD) Boston]
PM_{10}	Particulate matter smaller than or equal to 10 microns
PMTP	Project Maintenance of Traffic Plan (see MTP)
PPCMS	Preliminary Preferred Construction/Mitigation Scheme
ppm	Parts per million
psig	Pounds per square inch gauge
RCRA	Resources Conservation Recovery Act
REMI	Regional Economic Models, Inc.
RMTF	Regional Mitigation Task Force

ROD	Record of Decision
ROW	Right-of-way
RVP	Reid Vapor Pressure
SAIC	Science Application International Corporation
SB	Southbound
SBA	Small Business Administration (Federal)
SCADA	Supervisory Control and Data Acquisition
SD	Storm drain
SDC	Section Design Consultant
SER	Supportive Engineering Report (Appendix 1 of SEIS/R)
SEIS/R	Supplemental Environmental Impact Statement/Report
SHPO	State Historic Preservation Officer (see MHC)
SIP	State Implementation Plan
SO_x	Sulfur oxide
SO_2	Sulfur dioxide
SO_3	Sulfur trioxide
SPV	Seconds per vehicle
SS	Sanitary sewer
SSTC	South Station Transportation Center
TAC	Transportation Advisory Committee
TECC	Traffic and Emergency Control Center
TRANSCCOM	City/State Transportation and Construction Coordinating Committee
TRP	Traffic Relief Program
TSCS	Traffic Surveillance and Control System
TSM	Time Systems Management

TSP	Total suspended particulates
ug/l	Micrograms per liter
ug/m^3	Micrograms per cubic meter
um	Micron
u ohm	Micro ohm
USACE	U.S. Army Corps of Engineers
VHOC	Volatile halogenated compounds
VOC	Volatile organic compounds
VHT	Vehicle hours travelled
VMT	Vehicle miles travelled
VPD	Vehicles per day
VPH	Vehicles per hour
WB	Westbound

Index

INDEX

Above-grade construction activities, 20-4
Accident rates,
    existing, 3-19 to 3-20
    projected, 3-84 to 3-85
Acquisition, costs of, 20-38
Advisory Council on Historic Preservation, 10-1
Aesthetic and visual impacts. *See also* Visual characteristics; Visual impacts
    changes in construction impacts since FEIS/R, 20-104
    construction period mitigation measures, 20-104
    during construction, 20-83 to 20-88
Affordable housing, impacts on, 7-56
Agency jurisdiction, 1-10 to 1-11
Air pollutants, 4-1 to 4-2
    air quality standards for, 4-2
    toxic, 4-4 to 4-6
Airport Access Road, 2-10, 2-12 to 2-13
Airport Egress Road, 2-13
Airport-related business, impacts on, 7-41 to 7-42
Airport Service Road, 2-13
Airport transportation, long-term benefits, 19-12
Air quality, 4-1 to 4-72
    affected environment, 4-7 to 4-22
    air pollutants, 4-1 to 4-2
    changes since FEIS/R, 4-70 to 4-71, 20-102
    conformance with state implementation plan, 4-71
    construction impacts, 4-71, 20-53 to 20-61
    construction period mitigation measures, 20-102
    environmental consequences, carbon monoxide levels, 4-23 to 4-28, 4-32 to 4-37
    mesoscale analysis, 4-14 to 4-19
    microscale analysis, 4-23 to 4-28
    mitigation measures, 4-70
    pollutants for analysis, 4-6 to 4-7
    resolution of issues raised by public agencies, 4-71
    short-term impacts and long-term productivity, 19-1 to 19-12
    Spectacle Island, IIB 4-90
    standards and regulations, 4-2 to 4-6
Air quality impacts, 4-23
    carbon monoxide in proposed tunnels, 4-41 to 4-42
    proposed ventilation buildings, 4-46 to 4-70
    for South Boston Haul Road, 2-14 to 2-17, IIB 2-12
    Spectacle Island, IIB 4-125
    Third Harbor Tunnel toll plaza locations and, IIB 3-9 to 3-10
Air rights development,
    North End land use and, 8-24 to 8-25
    in project right-of-way, 18-1
Air transportation,
    existing, 3-21
    impacts on, 3-95 to 3-96

Albany Street area, historic resources and, 10-14, 10-15
Albany Street Extension, 10-14
AM peak hour,
  existing and projected traffic volumes, 3-39 to 3-52
  projected intersection operations in, 3-61
  projected speeds, 3-53
Anchored barges, visual impacts of, during construction, 20-87 to 20-88
Andrew Square,
  projected traffic operations, 3-70
  South Boston Bypass Road and, IIB 2-13
Anelex building, 20-18, 20-19
Aquatic impacts, of materials disposal program, IIB 4-136, IIB 4-140
Aquatic resources, Spectacle Island, IIB 4-87 to 4-89
Archaeological resources, 11-1 to 11-5
  affected environment, 11-1 to 11-14
  compared with FEIS/R, 11-15
  construction impact changes since FEIS/R, 20-104
  construction impacts, 20-89
  construction period mitigation measures, 20-104
  Cross Street Backlot site, 11-13, 11-14, III 43
  environmental consequences, 11-14
  Mill Pond Wharf site, 11-13, 11-14, III 43
  mitigation measures, 11-14
  Paddy's Alley site, 11-13, 11-14, III 43
  Section 4(f) evaluation, III 42 to 44
  Spectacle Island, IIB 4-91, IIB 4-124, III 43
Area managers, 20-15
Area North of Causeway Street,
  barge loading facilties, 20-35
  bicycling, 3-99
  business relocation in, 8-16
  Charles River tunnel design for, IIB 1-1, IIB 1-7
  comparison of Proposed Action to existing facilities, 2-3 to 2-4
  comparison of Proposed Action to FEIS/R Preferred Alternative, 2-10 to 2-11
  construction activities in, 20-2
  construction impacts,
    public transportation, 20-31
    traffic, 20-18 to 20-20
  construction materials movement in, 20-18 to 20-19
  construction work areas in, 20-19 to 20-20
  design objectives for, IIB 1-3 to 1-6
  economic activity, changes since FEIS/R, 7-20 to 7-23
  existing traffic operations, 3-10, 3-14
  historic resources, 10-8
  improved design for, IIB 1-1
  land use changes in, 8-2 to 8-4, 8-14 to 8-15, 8-40 to 8-41
  land use impacts in, 8-18 to 8-24
  noise barrier analysis, 5-26 to 5-27
  parking spaces displaced in, 20-17

  parking supply in, 3-19
  pedestrian circulation, 3-97, 20-27 to 20-28
  Preferred Alternative for, 2-10 to 2-11, II B1-1
  projected traffic operations, 3-66 to 3-67
  Proposed Action description in, 2-3
  proposed major traffic movements in, 2-4
  public transit impacts, 3-92
  relocation impacts, IIB 1-63 to 1-65
  roadway options for, evolution of, IIB 1-7 to 1-8
  Section 4(f) parklands affected in, III 2 to 21
  temporary access ramps in, 20-87
  transportation analysis, compared with FEIS/R, 3-106
  utility relocation, 20-51
  viaduct design for, IIB 1-1, IIB 1-7
  viaduct/tunnel design for, IIB 1-1, II B1-7
  visual characteristics, 9-1 to 9-2
  visual impacts, IIB 1-57 to 1-63, IIB 1-82
  wetlands and waterways mitigation, 14-51
Army Corps of Engineers, U.S.,
  impact assessment issues raised by, 2-16
  Third Harbor Tunnel depth and, 7-43
Arsenic, in dredged materials, 20-73
At-grade construction activities, 20-4
Atlantic Avenue alignment,
  changes since FEIS/R, 3-106 to 3-107
  of I-93 northbound lanes, 2-11
  projected traffic operations, 3-68
  Section 4(f) resources and, III 38
  South Station Headhouse and, 10-13
  traffic operations, 3-15
Automobile travel, time savings impacts, 7-51 to 7-54
Average weekday traffic (AWDT), 3-4, 3-27 to 3-39

Back Bay,
  residential impacts, 7-44
  retail district and impacts, 7-12, 7-38, 7-40
Backfilling,
  excavated materials for, IIB 4-16
  for Third Harbor Tunnel, 20-35, 20-74 to 20-75
Barge loading facilities, 20-5
  Bird Island Flats, 20-27, 20-35
  Boston Inner Harbor, 20-75
  Central Area, 20-20
  Charles River, 20-35, 20-79
  Fort Point Channel, 20-21, 20-78
  Lovejoy Wharf, 14-38
  South Boston, 20-24, 20-35
  visual impacts, during construction, 20-83 to 20-84

Barges,
    anchored, visual impacts of, during construction, 20-87 to 20-88
    movement of dredged materials by, IIB 4-11
    movement of excavated materials by, 20-5, 20-35 to 20-36, IIB 4-10 to 4-11
    navigation and, 20-32, 20-35 to 20-36
    offloading points for, IIB 4-10 to 4-11
Barricades and fences, during construction, visual impacts of, 20-88
Battleship Park, III 34
Beach Street ramps, 10-14
Beacon Hill, residential impacts, 7-43, 7-44
Bedford disposal site, IIB 4-57 to 4-61
    environmental impacts, IIB 4-92 to 4-96
Bicycling,
    Area North of Causeway Street, 3-99
    Central Area, 3-99
    construction impacts, 20-29 to 20-30
    existing, 3-22
    HOV system and, 3-99
    impacts on, 3-99
    South Boston Haul Road and, IIB 2-12
Bird Island Flats Park, III 33
Blackstone Block District,
    changes since FEIS/R, 10-17
    historic impacts and mitigation, 10-9 to 10-10
Blasting. *See also* Underwater blasting
    in Boston Inner Harbor, 20-34
    vibration and, 20-65
Blue Line Airport station,
    impacts to, 3-94
    pedestrian circulation and, 3-99
Boston, City of,
    economic characteristics, 7-1
    Economic Development and Industrial Corporation (EDIC), 8-10
    HOV issues raised by, 2-16
    noise ordinance, 5-23, 20-61
    office space in, 7-9
    population and employment growth in, 7-2
    property taxes, effect of construction on, 20-43
    retail space and trade in, 7-9 to 7-12
    visitors to, 7-18 to 7-20
Boston Bikemap, 20-29
Boston City Hospital, 20-49
Boston Consolidated Metropolitan Statistical Area (CMSA), 7-1
Boston population and employment growth in, 7-1, 7-4
Boston Gas Company, utility relocations, 12-12
Boston Harbor Cleanup Project, 18-2
Boston Harbor Islands State Park Master Plan,
    for Spectacle Island, IIB 4-115 to 4-116, IIB 4-141, III 28 to 29

Boston Inner Harbor,
  anchored barges in, 20-87 to 20-88
  area description, 14-16 to 14-18
  barge loading terminals, 20-75
  coastal wetland resource areas, 20-75
  construction impacts, 20-33 to 20-35, 20-70 to 20-75
  defined, 14-16
  dredging in, 20-34, 20-70 to 20-73
  elutriate analysis, 20-73 to 20-75
  filling of, 13-40, 20-76
  floodplain encroachment, 15-1 to 15-13
  hydrographics, 13-8, 13-11, 13-30 to 13-31
  long-term impacts, 14-43, 14-47
  marine resources, 13-13, 13-16, 13-31, 20-73 to 20-74
  navigation in, 14-24, 14-29, 14-48, 20-33 to 20-35
  sediment quality, 13-13, 13-31
  shipping, impacts on, 7-42 to 7-43
  siltation of, 19-12
  tunnel placement and backfilling, 20-75
  underwater blasting in, 19-12, 20-34, 20-70
  waterfront/filled tidelands, 14-29, 14-48 to 14-49
  water quality, 13-8 to 13-16, 13-30 to 13-31, 13-40
  water transportation, 14-24
  waterways/flowed tidelands, 14-24 to 14-29, 14-48
  wetlands resources, 14-18 to 14-24, 14-47 to 14-48
Boston Inner Harbor Water Transportation Study, 20-32
Boston Landmarks Commission, 10-1
Boston Marine Industrial Park, 7-42
Boston metropolitan area, defined, 7-1
Boston Outer Harbor, defined, 14-16
Boston Proper,
  existing legal parking spaces in, 3-19
  residential space, 7-13, 7-18
Boston Redevelopment Authority (BRA),
  Downtown Boston Interim Planning Overlay District (IPOD), 8-2
  Fort Point Channel District Plan, 8-27
  Harborpark, 8-7
  South Boston truck route studies, IIB 2-2 to 2-4
Boston Tea Party Museum, noise barrier analysis for, 5-28
Boston Water and Sewer Commission, New East Side Interceptor, relocation of, 12-4
Bracing, 20-8
Broadway Bridge, 10-16
  changes since FEIS/R, 10-19
  Section 4(f) evaluation, III 39, III 40, III 42
Building area forecast, 7-28 to 7-30
Bulfinch Triangle District,
  changes since FEIS/R, 10-17
  historic impacts and mitigation, 10-9
Bulfinch Triangle, IIB 1-50, IIB 1-65, IIB 1-66, IIB 1-95

Business districts, impacts on, 7-39 to 7-40
Business relocation, 8-14, 8-15 to 8-16
Business travellers, impact on, 7-49
Bus transportation,
  HOV system and, 3-94 to 3-95
  impacts to, 3-94 to 3-95, 20-30
  improvements to, 3-103

Cadmium, in dredged materials, 20-73
Callahan Tunnel,
  projected traffic operations, 3-27, 3-39, 3-53, 3-71, 3-72, 3-95
  traffic operations, 3-3, 3-4, 3-10, 3-21
Cambridge,
  excavated materials removal from, IIB 4-13
  land use, 8-4, 8-18 to 8-21
  North Point, 8-4, 8-21, 9-8, 14-12, 14-39
  Proposed Action description in, 2-3
CANA Project. *See* Central Artery North Area (CANA) Project Capacity, 3-6
  accident rates and, 3-85
  improvements with Proposed Action, 3-23
  projected duration of congestion and, 3-73
Carbon monoxide (CO), 4-1, 4-2, 4-6 to 4-7, 4-10
  concrete batch plant emissions, 20-57 to 20-59
  construction period emissions, 20-53 to 20-54
  mesoscale analysis of, 4-14 to 4-19
  microscale analysis of, 4-10 to 4-14, 4-23 to 4-28
  mobile source impacts, 4-69 to 4-70
  near toll plazas, 4-41
  projected, 4-29
  in proposed tunnels, 4-41 to 4-42
  State Implementation Plan and, 4-71
  ventilation building emissions, 4-48, 4-59
Casting basin,
  environmental permits for, 20-9 to 20-10
  Fort Point Channel, 14-43, 20-76 to 20-77
  visual impacts, 20-84
Causeway/North Washington Streets Historic District, IIB 1-66, IIB 1-90
  changes since FEIS/R, 10-17
  impacts and mitigation, 10-9
  Section 4(f) evaluation, III 36 to 38
Causeway Street, realignment of ramp near, 1-7
Central Area,
  at-grade construction in, 20-4
  barge loading facilities in, 20-20
  bicycling, 3-99
  construction impacts,
    public transportation, 20-31
    traffic, 20-20 to 20-23
  construction materials movement in, 20-20 to 20-22

- construction scheduling and sequencing, 20-11
- construction work areas in, 20-22 to 20-23
- economic activity, changes since FEIS/R, 7-23
- existing facilities in, 2-5
- existing traffic operations, 3-14 to 3-15
- historic resources, 10-9 to 10-14
- land use, 8-1, 8-4 to 8-8, 8-24 to 8-27, 8-41
- noise barrier analysis, 5-26 to 5-29
- office and job growth in, 1-4, 7-6, 7-9, 7-23
- parking, 3-19, 3-86, 3-91, 20-17
- pedestrian circulation, 3-97 to 3-98, 20-28
- pedestrian visual experiences in, 20-88
- Proposed Action compared to FEIS/R Preferred Alternative, 2-11
- Proposed Action description, 2-4 to 2-5
- public transit impacts, 3-92, 3-94
- surface streets in, 2-4 to 2-5
- temporary signs in, 20-87
- traffic, 2-5, 3-36, 3-39, 3-52, 3-67 to 3-69, 20-20 to 20-23
- transportation analysis, compared with FEIS/R, 3-106 to 3-107
- underpinning and bracing in, 20-8
- utility relocations, 12-12, 20-51 to 20-52, 20-101
- ventilation buildings, 4-46
- vibration impacts, 20-69
- visual characteristics, 9-2 to 9-4
- visual impacts, 9-6

Central Artery,
- capacity of, 1-4, 3-1, 3-6
- congestion on, 3-2 to 3-3, 3-14 to 3-15
- deficiencies of, 3-2 to 3-3
- defined, 2-1
- existing facilities, 2-5
- existing on- and off-ramps, 3-14
- functions of, 3-2
- history of, 1-5
- Logan Airport traffic and, 3-94 to 3-95
- maintenance of traffic on, 20-11
- projected congestion, 3-72
- projected traffic operations, 3-27, 3-39, 3-52 to 3-57, 3-67
- removal of, 19-2 to 19-13
- safety of, 3-19 to 3-20
- traffic operations, 3-4, 3-6 to 3-16, 3-14, 3-27
- transportation demand and, 1-4
- widening of, 2-1

Central Artery corridor,
- changes since FEIS/R, 9-20
- construction activities in, 20-2
- excavated materials, removal from area, IIB 4-13 to 4-14
- pedestrian circulation, 3-22, 20-28

  - visual characteristics, 9-1 to 9-4
  - visual impacts, 9-6, 9-11 to 9-15, 9-18
- Central Artery/Leverett Circle Connection Feasibility Study, IIB 1-2
- Central Artery North Area (CANA) Project, 2-3, 3-3, IIB 1-1, IIB 1-2, IIB 1-6
  - Chapter 91 Special Conditions, 8-18, IIB 1-99 to 1-101
  - connections to, 20-4
  - construction impacts, IIB 1-69
  - description, IIB 1-9, IIB 1-10, IIB 1-12 to 1-14
  - land use changes, 8-2, 8-4
  - land use impacts, IIB 1-51
  - mitigation measures, IIB 1-98 to 1-100
  - parklands impacts, IIB 1-57
  - Proposed Action and, 18-6
  - purpose of, IIB 1-1 to 1-2
  - Section 4(f) parkland, III 8
  - Tower A and, 10-8
  - traffic operations, IIB 1-15, IIB 1-19, IIB 1-22
  - visual characteristics, 9-1
  - visual impacts, IIB 1-61
- Charles River. *See also* Lower Charles River
  - barge loading terminal operations, 20-79
  - construction impacts,
    - navigation, 20-32 to 20-33
    - water resources, 20-79
  - excavated materials removal from, IIB 4-13
  - filling of, 20-79
  - floodplain encroachment, 15-1 to 15-13
  - inland wetland resource areas, 20-79
  - navigation on, 14-8 to 14-11, 14-34, 14-38
  - realignment of ramp near, 1-7
  - siltation of, 19-12
- Charles River area,
  - bicycling, 3-99
  - pedestrian circulation, 3-21 to 3-22, 3-97, 20-27 to 20-28
  - visual characteristics, 9-2
  - visual impacts, 9-6, 9-7 to 9-8
- Charles River area interchange, visual impacts, 9-8
- Charles River Basin Historic District, IIB 1-66
  - changes since FEIS/R, 10-17
  - impacts and mitigation, 10-8
  - Section 4(f) evaluation, III 35 to 36
- Charles River bridges, 2-3
  - above-grade construction of, 20-4
  - changes since FEIS/R, 9-19
  - construction impacts on navigation, 20-32 to 20-33
  - design of, 9-17 to 9-18
  - materials delivery for, 20-19
  - projected duration of congestion, 3-72 to 3-73
  - projected traffic operations on, 3-66

- shadow effects, 18-2
- visual impacts, 9-6, 9-7 to 9-8, 9-17 to 9-18
- water resources and, 20-79
- wetlands and waterways impacts of, 14-30 to 14-38

Charles River Building, IIB 1-44, IIB 1-50, IIB 1-51, 5-27, 8-21

Charles River Dam,
- New, IIB 1-42 to 1-54, IIB 1-44, IIB 1-48, IIB 1-49, IIB 1-52, IIB 1-53, IIB 1-54, IIB 1-59, IIB 1-71, IIB 1-77, IIB 1-96, IIB 1-97
- Old, IIB 1-1, IIB 1-24, IIB 1-48

Charles River Esplanade, IIB 1-1 to 1-3, IIB 1-24, IIB 1-53, IIB 1-56, IIB 1-71, IIB 1-80, IIB 1-81, IIB 1-88, IIB 1-92, IIB 1-97 to 1-102
- Metropolitan District Commission plans for, IIB1-2, IIB1-3
- Section 4(f) parkland, III 3 to 6

Charles River high bridge, airport traffic and, 3-21

Charlestown,
- City Square, 3-14, 3-67, 9-1
- economic activity in, 7-20
- excavated materials removal from, IIB 4-9, IIB 4-13
- filled tidelands, 14-12
- land use, 8-2 to 8-4, 8-18
- Proposed Action description in, 2-3 to 2-4
- residential area and impacts, 7-13, 7-18, 7-44
- as tourist destination area, 7-47

Charlestown-Boston ferry, 3-105

Charlestown Navy Yard area, projected truck traffic, 3-75

Chinatown,
- historic resources impacts, 10-14 to 10-15
- land use, 8-8, 8-15, 8-27, 8-30 to 8-31, 8-41
- parkland, III 31 to 32
- pedestrian circulation, visual impacts, 9-13 to 9-14
- retail impacts, 7-38, 7-40
- vibration impacts, 20-69

Christopher Columbus Park, III 32

Circumferential transit alternatives, 3-102

City Square, Charlestown,
- existing traffic operations, 3-14
- projected traffic operations, 3-67
- visual characteristics, 9-1

Clamshell dredging, in Boston Inner Harbor, 20-70 to 20-73

Clay and till,
- disposal of, IIB 4-43 to 4-127
- in dredged and excavated materials, IIB 4-32, IIB 4-36 to 4-40
- transport of, IIB 4-43 to 4-44
- volume of, IIB 4-43

CMSA. *See* Boston Consolidated Metropolitan Statistical Area

Coastal wetland resource areas,
- Boston Inner Harbor, 20-75
- Fort Point Channel, 20-78 to 20-79

Cockroach mitigation, 20-93, 20-104

Combined sewer outfall (CSO) project, 13-27, 13-36 to 13-37, 13-38, 18-2
Combined sewer overflows (CSOs), 13-2, 13-7, 13-17, 13-29, 13-36 to 13-37, 13-38, 13-40, 13-41
Commercial Avenue, existing traffic operations, 3-14
Commercial vehicles (CV) only lane, 3-16
Commonwealth Flats area, replacement parking facility, 3-91
Commuter rail,
  impact on, 3-92 to 3-93
  improvements to, as mitigation measures, 3-102 to 3-103
  Logan Airport traffic and, 3-96
Commuter traffic,
  bicycle, 3-22
  capacity constraints on, 7-36
  construction impacts, 20-16 to 20-17
  pedestrian, 3-22
  regional, growth in, 7-2
  in South Boston, 3-16
  in study area, 7-5
Concrete batch plant,
  East Boston, 20-4 to 20-5
  fugitive dust emissions from, 20-57 to 20-59
  gaseous emissions from, 20-59
  visual impacts, 20-83, 20-86
Concrete deliveries,
  Area North of Causeway Street, 20-19
  Central Area, 20-21 to 20-22
  Interchange Area, 20-23
  visual impacts, 20-86
Condominium conversions, 7-18 Congestion. *See* Traffic congestion Consolidated Rail Corp. (Conrail),
  railroad cut, IIB 2-2
  railroad right-of-way, IIB 2-1
Constitution Beach, IIB 4-130
Construction activities, 20-1 to 20-106
  above-grade construction, 20-4
  at-grade construction, 20-4
  changes since FEIS/R, 20-99 to 20-106
  cut-and-cover construction, 20-2 to 20-3
  labor costs for, 20-38
  logistics, 20-4 to 20-7
  mitigation measures, 20-1, 20-93 to 20-99
  proposed construction plan, 20-1 to 20-20 to 16
  reinforced concrete immersed tube, 20-3 to 20-4
  resolution of issues raised by public agencies, 20-104 to 20-106
  short-term impacts and long-term productivity, 19-1 to 19-12
  special methods and measures, 20-7 to 20-10
  steel shell immersed tube, 20-3
  total costs of, 20-38
  utilities, 20-7

Construction areas,
  defined, IIB 4-7
  materials movement options for, IIB 4-11 to 4-15
  visual impacts, 20-84
Construction drainage, 20-81
Construction employment, 20-36 to 20-38
Construction equipment,
  gaseous emissions from, 20-59
  movement of, visual impacts of, 20-86
  vibration levels of, 20-67
Construction impacts, 20-16 to 20-93
  aesthetic and visual considerations, 20-83 to 20-88
  air quality, 4-71, 20-53 to 20-59
  archaeology, 20-88 to 20-89
  barge traffic, 20-35 to 20-36
  bicycling, 20-29 to 20-30
  bus transportation, 20-30
  CANA project, IIB 1-69
  commuter travel, 20-16 to 20-17
  economic activity, 20-36 to 20-50, 20-38 to 20-42
  fiscal, 20-46
  historic resources, 10-4 to 10-5, 20-88 to 20-89
  homeless people, 20-46 to 20-47
  housing, 20-45
  industrial and wholesale businesses, 20-44
  institutions, 20-48 to 20-49
  materials disposal program, IIB 4-144 to 4-145
  navigation, 20-32 to 20-36
  noise, 20-59 to 20-63
  nuisance abatement, 20-89 to 20-93
  office market, 20-42 to 20-44
  Option S Modified, IIB 1-68 to 1-71, IIB 1-73
  Option T Modified, IIB 1-67 to 1-71, IIB 1-73 to 1-75
  Option Z Modified, IIB 1-68 to 1-71, IIB 1-75
  parking, 20-17
  Paul Revere Landing Park, IIB 1-71
  pedestrian circulation, 20-27 to 20-28
  public transportation, 20-30 to 20-32
  resolution of issues raised by public agencies, 20-104 to 20-106
  retail businesses, 20-43 to 20-44
  Scheme 5A Modified, IIB 1-68 to 1-72
  tourism, 20-48 to 20-49
  traffic,
    Area North of Causeway Street, 20-18 to 20-20
    Central Area, 20-20 to 20-23
    detours and diversions, 20-27
    East Boston/Logan Airport Area, 20-26 to 20-27
    Interchange Area, 20-23 to 20-24
    South Boston, 20-24 to 20-25

- South Boston Bypass Road Area, 20-25
- traffic and transportation, 20-16 to 20-36
- utilities, 20-49 to 20-53
- vibration, 20-63 to 20-69
- water resources, ecology, and wetlands, 20-69 to 20-82

Construction management, 20-13 to 20-16
- construction plan, 20-1 to 20-16
- final design, 20-13 to 20-14
- preliminary engineering/supplemental environmental impact assessment, 20-13
- techniques, 20-14 to 20-16

Construction Management Plan and Mitigation Program, 20-13

Construction managers, 20-15 to 20-16

Construction materials movement, 20-4 to 20-5
- Area North of Causeway Street, 20-18 to 20-19
- Central Area, 20-20 to 20-22
- East Boston/Logan Airport Area, 20-26
- Interchange Area, 20-23 to 20-24
- South Boston, 20-24 to 20-25
- South Boston Bypass Road Area, 20-26
- South Boston Haul Road and, IIB 2-2
- visual impacts, 20-86

Construction methods, 20-99 to 20-100

Construction noise, 20-59 to 20-63

Construction scheduling and sequencing, 20-10 to 20-12
- Area North of Causeway Street, 20-11
- Central Area, 20-11
- East Boston/Logan Airport Area, 20-12 to 20-13
- fast track program, 20-10
- Interchange Area, 20-11 to 20-12
- South Boston, 20-12
- Third Harbor Tunnel, 20-12

Construction work areas, 20-7
- Area North of Causeway Street, 20-19 to 20-20
- Central Area, 20-23
- East Boston/Logan Airport Area, 20-26 to 20-27
- Interchange Area, 20-24
- South Boston, 20-25
- South Boston Bypass Road Area, 20-26

Contaminated soil, soil characterization program and, IIB 4-16, IIB 4-21, IIB 4-25 to 4-27

Convention industry, 7-44 to 7-45, 7-49

Conveyor system, 20-10, 20-20, 20-105

Cross Street Backlot site, 11-13, 11-14
- Section 4(f) evaluation, III 43

Cultural resources, Spectacle Island, IIB 4-91

Curley Memorial Park, III 32

Customer base, impacts on, 7-38

Custom House District, historic impacts and mitigation, 10-12

Cut-and-cover construction, 20-2 to 20-3

Daily traffic volumes, existing and projected, 3-27 to 3-39
Debris, removal of, 20-6 to 20-7, 20-19, 20-21
Delay reduction, for industrial/manufacturing sector, 7-40 to 7-41
Demolition,
  fugitive dust emissions from, 20-55 to 20-57
  visual impacts of, 20-84 to 20-85
Designated Port Area, improved access to, 14-48
Design modifications, IID 1 to 4
  East Boston/Logan Airport Area, IID 3 to 4
  Interchange Area, IID 1 to 2
  other, IIC 1ff
  since FEIS/R, 8-14 to 8-15
  South Boston/South Boston Haul Road Area, IID 2 to 3
Detection-of-movement programs, 20-8 to 20-9
Detours and diversions, 20-20, 20-24, 20-27, 20-100
Dewatering, 20-8 to 20-9, 20-81, 20-89
Dewey Square tunnel, 2-5, 2-7
  maintenance of traffic in, 20-11
  ventilation of, 4-59
Disposal sites. *See also* Landfills; Inland disposal sites; Marine disposal sites
  for acceptable dredged materials, IIB 4-41 to 4-42
  for clay and till, IIB 4-38 to 4-40
  environmental impact comparisons, IIB 4-127 to 4-152
  environmental impacts, IIB 4-91 to 4-127
    East Brookfield Site, IIB 4-101 to 4-105
    Governors Island Flats, IIB 4-105 to 4-4 to 108, IIB 4-130
    Hull Bay, IIB 4-108 to 4-110, IIB 4-130
    Logan Airport North, IIB 4-110 to 4-113, IIB 4-130
    Logan Airport West, IIB 4-113 to 4-115, IIB 4-130
    Massachusetts Bay Disposal Site, IIB 4-92
    Site BED10 (Bedford), IIB 4-92 to 4-96
    Site MAL01 (Malden/Revere), IIB 4-96 to 4-99
    Site WEY13 (Weymouth), IIB 4-99 to 4-101
    Spectacle Island, IIB 4-115 to 4-127
  for excavated materials,
    non-ocean disposal, IIB 4-50 to 4-56, IIB 4-129
    ocean disposal, IIB 4-44 to 4-50, IIB 4-129
  existing conditions, IIB 4-57 to 4-91
    East Brookfield Site, IIB 4-69 to 4-75
    Governors Island Flats, IIB 4-75 to 4-78
    Hull Bay, IIB 4-78 to 4-79
    Logan Airport North, IIB 4-79 to 4-82
    Logan Airport West, IIB 4-82 to 4-83
    Site BED10 (Bedford), IIB 4-57 to 4-61
    Site MAL01 (Malden), IIB 4-61 to 4-64
    Site WEY13 (Weymouth), IIB 4-65 to 4-69
    Spectacle Island, IIB 4-83 to 4-91
  identification of, IIB 4-27 to 4-31
  inland, IIB 4-3 to 4-4, IIB 4-28 to 4-31, IIB 4-131 to 4-134, IIB 4-145 to 4-149

marine, IIB 4-4, IIB 4-41 to 4-43, IIB 4-130
    non-ocean, IIB 4-50 to 4-56
    ocean, IIB 4-44 to 4-50
  options for, IIB 4-3 to 4-5
  physical requirements of, IIB 4-34 to 4-35
  potential supplementary sites at Logan Airport, IIB 4-153 to 4-154
  program implementation issues, IIB 4-35 to 4-36
  screening, IIB 4-6 to 4-7, IIB 4-31 to 4-36
  for unaccpetable dredged materials, IIB 4-42 to 4-43
Disposal Site Screening Report, IIB 4-28
Dockside Place, noise barrier analysis for, 5-28
Dorchester Avenue, design of, 10-16
Downtown Boston Interim Planning Overlay District (IPOD), 8-2
Downtown Crossing, 7-12, 7-38, 7-39
Drainage,
  from construction areas, 20-81
  proposed project system, 13-37 to 13-39
Dredged materials,
  acceptable, disposal of, IIB 4-40 to 4-42
  categories of, IIB 4-32
  chemical quality of, IIB 4-21
  defined, IIB 4-1 to 4-2
  disposal of, IIB 4-40 to 4-43, 1-9
  disposal options for, IIB 4-3 to 4-6
  disposal program requirements for, IIB 4-1 to 4-2
  disposal sites for, IIB 4-41 to 4-43
  from Interchange Area, 20-23
  inland disposal of, IIB 4-3 to 4-5
  movement options, IIB 4-7 to 4-15
  ocean disposal of, IIB 4-4 to 4-5
  quantities of, IIB 4-15
  transport of, IIB 4-41, IIB 4-42
  unacceptable, disposal of, IIB 4-42 to 4-43
  volume of, IIB 4-41, IIB 4-42
Dredging,
  Boston Inner Harbor, 20-34, 20-70 to 20-73
  Fort Point Channel, 20-76
  water quality and, 20-73 Dry Dock #3, 20-35

Earthworking activities, fugitive dust emissions from, 20-55
East Boston Interim Planning Overlay District (IPOD), 8-12
East Boston/Logan Airport Area. *See also* Logan Airport
  barge loading facilities, 20-27, 20-35
  compared to FEIS/R Preferred Alternative, 2-12 to 2-13
  concrete batch plant, 20-4 to 20-5, 20-86
  construction impacts, 20-32
  construction materials movement in, 20-26 to 20-27
  construction scheduling and sequencing, 20-12
  construction traffic impacts, 20-27

- construction work areas, 20-26 to 20-27
- conveyor system, 20-10
- design modifications considered, IID 3 to 4
- economic activity, 7-25
- excavated materials movement in, 20-5, IIB 4-8 to 4-9
- excavated materials removal from, IIB 4-13
- existing facilities, 2-10
- existing traffic operations, 3-16
- industrial/manufacturing space in, 7-13
- land use, 8-12, 8-12 to 8-14, 8-15, 8-37 to 8-39, 8-42
- noise barrier analysis, 5-29
- parking, 3-19, 3-91, 20-18
- parkland, III 33 to 34
- pedestrian circulation, 3-98 to 3-99, 20-29
- projected traffic operations, 3-36, 3-39, 3-52, 3-71 to 3-72
- projected truck traffic, 3-75, 3-84
- Proposed Action description, 2-9
- proposed traffic improvements, 2-10
- public transportation impacts, 3-94, 20-32
- realignment in, 1-9
- residential area and impacts, 7-13, 7-18, 7-43 to 7-44
- Third Harbor Tunnel toll plaza location, IIB 3-1 to 3-15
- transportation analysis, 3-107 to 3-108
- utility relocations, 12-12, 20-53
- ventilation buildings, 4-46
- visual characteristics, existing environment, 9-5

East Boston Memorial Stadium Park,
- changes since FEIS/R, 8-42
- construction impacts, 20-86
- land use impacts, 8-37
- long-term benefits, 19-13
- noise barrier analysis, 5-29
- noise impacts, IIB 3-10 to 3-12
- pedestrian circulation, 3-99
- Section 4(f) evaluation, III 22 to 27

East Brookfield disposal site, IIB 4-69 to 4-75, IIB 4-101 to 4-105

East Cambridge,
- changes in economic activity since FEIS/R, 7-25
- industrial/manufacturing space in, 7-13

Ecology,
- changes in construction impacts since FEIS/R, 20-104
- construction period mitigation measures, 20-102

Economic activity,
- affected environment, 7-1 to 7-25
- compared with FEIS/R, 7-57, 20-100 to 20-101
- construction impacts, 20-36 to 20-49
- environmental consequences, 7-25 to 7-56
- forecasts of, 7-26 to 7-34
- geographic analysis of, 7-1

- issues raised by agencies, 7-57
- mitigation measures, 7-56

Economic Development and Industrial Corporation (EDIC), 8-10

Economic impacts,
- construction period mitigation measures, 20-98 to 20-99
- fiscal impacts, 7-54 to 7-56
- industrial, wholesale, and maritime business impacts, 7-40 to 7-43
- institutions, impacts on, 7-50
- methodology of, 7-30 to 7-34
- office impacts, 7-34 to 7-37
- overall impacts, 7-51
- residential impacts, 7-43 to 7-44
- retail business impacts, 7-37 to 7-40
- for South Boston Haul Road, IIB 2-25 to 2-27
- tourism impacts, 7-44 to 7-50
- transportation system efficiency benefits, 7-51 to 7-54

Edward Everett House, noise barrier analysis for, 5-26

Elevated roadways, construction activities, 20-2

Elutriate analysis,
- Boston Inner Harbor, 20-73
- Fort Point Channel, 20-76 Employment,
- construction impacts, 20-101
- forecasts of, 7-26 to 7-30
- generated by Proposed Action, 20-36 to 20-38
- growth in, 7-2 to 7-8
- impacts on, 7-34, 7-36 to 7-37, 7-51, 20-38. 20.42
- office, 7-34
- regional growth in, 7-2
- in study area, 7-4 to 7-5
- travel increase related to, 3-1 to 3-2

Endangered species, construction impacts to, 20-82 to 20-83

Energy,
- affected environment, 6-1
- compared with FEIS/R, 6-3 to 6-5
- consumption of, 6-1 to 6-3, 18-2
- mitigation measures, 6-3

Environment, short-term uses of, 19-1 to 19-13

Environmental permits and regulations, 1-10
- for casting basin, 20-9 to 10
- for materials disposal, IIB 4-4 to 4-5

Equivalent noise level, 5-1

Essex/Kingston Textile District, historic impacts and mitigation, 10-14

Excavated materials,
- as backfill, IIB 4-16
- categories of, IIB 4-32
- chemical quality of, IIB 4-16, IIB 4-19
- defined, IIB 4-1 to 4-2
- disposal of, 1-8, IIB 4-43 to 4-127
  - inland, IIB 4-3 to 4-5

        non-ocean, IIB 4-50 to 4-56
        ocean, IIB 4-4 to 4-5, IIB 4-6, IIB 4-44 to 4-50
        options for, IIB 4-3 to 4-6
        program requirements, IIB 4-1 to 4-2
    floating materials in, IIB 4-47 to 4-50
    from Area North of Causeway Street, 20-18
    from Central Area, 20-20 to 20-21
    from Interchange Area, 20-23, 20-24
    movement of, 20-5, 20-86, IIB 4-7 to 4-15, IIB 4-43 to 4-44
    odors from, 20-93
    physical characteristics of, IIB 4-21 to 4-24
    quantities of, IIB 4-15
    removal of, 20-5 to 20-6
    separability of, IIB 4-24
    stockpile sites for, IIB 4-40
    volume of, IIB 4-43
Excavation, visual impacts of, 20-85
Exhaust odor control, 20-93

Faneuil Hall, 7-12
    historic impacts and mitigation, 10-11
    impacts on, 7-38, 7-39
    land use, 8-7, 8-25
    as tourist destination area, 7-47
Fast track construction program, 20-10
Federal Aviation Administration (FAA), Spectacle Island final elevation and, IIB 4-116
FEIS/R,
    air quality analysis, 4-7
    air quality analysis changes since, 4-70 to 4-71
    alternatives discussed in, 1-6
    archaeological resources, 11-15
    construction period changes since, 20-99 to 20-106
    energy analysis, 6-3 to 6-5
    land use changes since, 8-1 to 8-2, 8-40 to 8-42
    noise impact changes since, 5-29
    outstanding issues in, 1-1, 1-2, 1-3
    project design changes since, 8-14 to 8-15
    public transit changes since, 3-20 to 3-21
    purpose and need for action changes since, 1-4 to 1-5
    regional economy changes since, 7-1 to 7-25
    time savings estimates, 7-57
    transportation changes since, 3-106 to 3-108
    utility impacts, 12-4 to 12-15
    vibration impact changes since, 5-36
    water quality issues changes since, 13-40 to 13-41
    wetlands and waterways changes since, 14-51 to 14-52
Ferries. *See* Water transportation
FHWA outdoor noise abatement criterion, 5-16

Filling,
    Charles River, 20-79
    Fort Point Channel, 20-77 to 20-78
    Millers River, 20-81
Final design, construction management during, 20-13 to 20-14
Financial District,
    economic activity in, 7-23
    land use, 8-7, 8-26 to 8-27
    retail impacts on, 7-38, 7-39
Fiscal impacts, 7-54 to 7-56
    of construction, 20-46
Fisheries,
    Boston Inner Harbor, 14-19, 14-47
    Charles River, 14-6, 14-32 to 14-33
    Fort Point Channel, 14-14 to 14-15
    protection of, 20-74
Flaherty Park, III 32 to 33
    land use impacts, 8-37
    noise barrier analysis for, 5-29
    noise impacts, IIB 2-20 to 2-23
Floatables, ocean disposal of, IIB 4-47 to 4-50
Floodplains, 15-1 to 15-13
    affected environment, 15-11
    environmental consequences, 15-11 to 15-12
    impacts, compared to FEIS/R, 15-13
    mitigation measures, 15-12
    Spectacle Island, IIB 4-90, IIB 4-124
Fort Point Channel,
    anchored barges in, 20-88
    area description, 14-2 to 14-3
    barge loading facilities, 20-21, 20-78
    bridges crossing, 20-79
    bulkhead, 10-15, 10-16
    casting basin, 14-43, 20-76 to 20-77, 20-78
    coastal resource wetland areas, 20-80
    construction impacts, 20-33, 20-75 to 20-79
    dredged materials removal from, IIB 4-14 to 4-15
    filling, 13-27 to 13-29, 20-77 to 20-78
    floodplain encroachment, 15-1 to 15-13
    hydrographics, 13-1 to 13-2, 13-27 to 13-29, 13-41
    long-term impacts to, 14-39 to 14-40
    marine life, 13-8, 13-29 to 13-30
    Memorandum of Agreement and, 10-13, 10-16
    navigation in, 14-15 to 14-16, 14-42
    Proposed Action permanent elements, 13-26 to 13-27
    realignment near, 1-6
    reduction in filling, 13-40, 14-51 to 14-52
    removal of structures from, 13-39
    Seaport Access Road tunnel dredging, 20-76

seawater users, 20-78, 20-79, 20-82
sediment quality, 13-7 to 13-8, 13-30
siltation of, 19-2
as tourist destination area, 7-47
tunnel construction, 20-2, 20-3 to 20-4, 20-7 to 20-77
ventilation building impacts, 14-43
visual access to, 14-43
waterfront/filled tidelands, 14-16, 14-42 to 14-43
water quality, 13-1 to 13-8, 13-26 to 13-30, 13-41
water quality changes since FEIS/R, 13-40
water quality mitigation measures, 13-39
waterways/flowed tidelands, 14-15 to 14-16, 14-41 to 14-142
wetland resources, 14-13 to 14-15, 14-40 to 14-41
Fort Point Channel alignment, of I-93 northbound lanes, 2-11
Fort Point Channel area,
constraints to ventilation buildings in, 4-44
industrial impacts, 7-42
land use, 8-7 to 8-8, 8-27, 8-41
office space projections, 20-43
pedestrian circulation, 3-98
projected office space, 7-5
South Boston Bypass Road and, IIB 2-11
visual characteristics, 9-5
Fort Point Channel bulkhead, changes since FEIS/R, 10-18 to 10-19
Fort Point Channel Design Development Guidelines, 10-5
Fort Point Channel Historic District,
changes since FEIS/R, 10-18 to 10-19
impacts to, 10-15 to 10-17
Plan, 8-27
Section 4(f) evaluation, III 38 to 42
Fort Point Channel Project Report, 8-27
Framingham Commuter Rail extension, 3-103
Freedom Trail, 3-22
Freight traffic, airport-related, 7-41 to 7-42
Frontage road system, 2-1, 2-2, 2-6
Fugitive dust emissions, during construction, 20-54 to 20-59
Fulton/Commercial Streets District, historic impacts and mitigation, 10-11

Gaseous emissions, during construction, 20-54, 20-59
Gateway Park, III 32
Gateways,
changes since FEIS/R, 9-19 to 9-20
visual impacts, 9-8 to 9-11, 9-18
General Ship, 20-34, 20-82, 20-103
Geology. *See* Soils and geology Gillette Company, 20-103
construction impacts, 20-82
cooling water intake system, 13-29, 13-35 to 13-36
Gilmore Bridge, 3-14

Government Center,
    economic activity in, 7-23
    land use, 8-7, 8-26
Governors Island Flats disposal site, IIB 4-75 to 4-78
    compared with other sites, IIB 4-130
    environmental impacts, IIB 4-105 to 4-108
    for unacceptable dredged materials, IIB 4-43
Gridley Street District, 10-12 to 10-13, 10-18 Groundwater, 13-23 to 13-26
    construction impact changes since FEIS/R, 20-103
    historic resources and, 20-89
    impacts on, 13-35, 13-41
    mitigation measures, 13-40
    monitoring, 19-2
    studies, 13-25 to 13-26
    tidal influences on, 13-25 to 13-26
GSA parcel park, IIB 1-53, IIB 1-56, IIB 1-71, IIB 1-92, IIB 1-97, IIB 1-101

Harbor Lobster, 20-82
Harborpark, 8-7
Harbor Towers, 5-28
Haymarket area,
    pedestrian circulation, visual impacts, 9-13
    replacement parking facility, 3-86. 3.91
Haymarket Orange/Green Line station, 3-92, 3-94
Hazardous cargo vehicles, South Boston Bypass Road alternatives and, IIB 2-7 to 2-10
Hazardous materials, soil characterization program and, IIB 4-25
Herald Street local roadway connection, 3-107
High-Occupancy Vehicle (HOV) system, 2-1
    bicycling and, 3-99
    bus transportation and, 3-92, 3-94 to 3-95
    components of, 2-14 to 2-15
    design modifications considered, IID 2, IID 3
    energy savings and, 6-3
    improvements with Proposed Action, 3-24
    Logan Airport traffic and, 3-96
    as mitigation measure, 3-104 to 3-105
    projected daily traffic volumes, 3-36
    Proposed Action description of, 2-14 to 2-15
    purpose of, 2-2
    South Boston Bypass Road and, 3-108, IIB 2-8, IIB 2-10
    toll plaza locations and, IIB 3-2 to 3-5, IIB 3-9
Highway-related retail businesses, 20-44
Highway and street network, 3-2 to 3-4
Hingham-Boston commuter boat, 3-105
Historic American Building Survey (HABS), 10-4
Historic American Engineering Record (HAER), 10-4
Historic resources, 10-1 to 10-19
    affected environment, 10-1 to 10-4
    Area North of Causeway Street, 10-8

- Central Area, 10-9 to 10-14
- changes since FEIS/R, 10-1, 10-17 to 10-19, 20-104
- construction impacts, 10-4 to 10-5, 20-88 to 20-89, 20-104
- Interchange Area, 10-14 to 10-15
- long-term effects, 10-5
- mitigation measures, 10-4 to 10-17, 20-104
- Project Conservator for, 10-4
- resolution of issues raised by public agencies, 10-19
- Section 4(f) evaluation, III 34 to 42
- South Boston, 10-15 to 10-17
- Spectacle Island, IIB 4-91, IIB 4-124, III 28
- vibration and, 20-67 to 20-69

Hook Lobster, 20-82, 20-103
Hospitals, impacts on, 7-50, 20-49
Hotel business, 7-18 to 7-20, 7-49
House of Bianchi, 5-31, 10-16
Housing, impacts on, 7-43 to 7-44, 7-56, 20-44 to 20-46, 20-48
Hudson Street, noise barrier analysis for, 5-29
Hull Bay disposal site, IIB 4-78 to 4-79, IIB 4-108 to 4-110, IIB 4-130
Hydrocarbons (HC), 4-1, 4-6 to 4-7
- mesoscale analysis of, 4-19
- projected, 4-23, 4-28 to 4-32, 4-37 to 4-41
- State Implementation Plan and, 4-71

I-90,
- extension of, 2-1
- HOV system, 3-104 to 3-105
- Proposed Action description, 2-6 to 2-7
- service roads, 3-107

I-93,
- changes since FEIS/R, 3-106
- defined, 2-1
- HOV system, 3-36, 3-104 to 3-105
- northbound lanes,
  - Atlantic Avenue alignment, 2-11
  - Fort Point Channel alignment, 2-11
- projected traffic operations, 3-36, 3-57, 3-60, 3-73
- Proposed Action description, 2-6 to 2-7
- visual impacts, 9-9

I-93/I-90 Interchange,
- changes since FEIS/R, 3-107
- HOV system, 2-14
- improvements to, 2-12
- Proposed Action description, 2-6 to 2-7

I-93/Massachusetts Avenue intersection, 3-107
I-93/Route 1 interchange, 2-3, 18-6
Immersed tube tunnel,
- backfilling, 20-35
- construction, 20-2, 20-3 to 4, 20-9 to 10, 20-12

placement of, 20-34 to 20-35
reinforced concrete, 20-3 to 20-4
steel shell, 20-3
Incident control, in tunnels, 4-42
Industrial economy, 7-12 to 7-13, 7-40 to 7-43, 20-44
Industrial seawater use, 13-23, 13-35 to 13-36, 20-82
Industrial Source Complex Short-Term (ISCST) air quality model, 20-57
Inflammable cargo routes, 3-17, 3-84 to 3-85
Inflammable cargo vehicles, prohibition of, 3-84
Inland disposal sites, IIB 4-3 to 4-4, IIB 4-28 to 4-31, IIB 4-131 to 4-134. *See also* Landfills
disposal approaches using, IIB 4-145 to 4-152
environmental impacts of, IIB 4-145 to 4-149
Inland wetland resource areas,
Charles River, 20-79
Millers River, 20-80 to 20-81 Institutions, 7-50, 20-48 to 20-49
Integrated Pest Management (IPM) Plan, 20-90 to 20-91, 20-92
Interchange Area. *See also* I-93/I-90 Interchange; Massachusetts Avenue Interchange
changes in economic activity since FEIS/R, 7-23
construction activities in, 20-2
construction materials movement in, 20-23 to 20-24
construction scheduling and sequencing, 20-11 to 20-12
construction traffic impacts, 20-23 to 20-24
construction work areas, 20-24
deep excavations at, 17-12
design modifications considered, IID 1 to 2
detours and diversions, 20-23
excavated materials removal from, IIB 4-14
existing facilities, 2-7
existing traffic operations, 3-15 to 3-16
frontage road system in, 2-6
historic resources, 10-14 to 10-15
land use, 8-1, 8-8 to 8-10, 8-27 to 8-32, 8-41
noise barrier analysis, 5-28 to 5-29
parking supply in, 3-19
pedestrian circulation, 3-98, 20-28
projected traffic operations, 3-69
Proposed Action compared to FEIS/R, 2-11 to 2-12
Proposed Action description, 2-6
proposed major traffic movements, 2-7
replacement parking in, 3-91
surface streets in, 2-6
temporary bridges in, 20-87
transportation analysis, compared with FEIS/R, 3-107
utility relocation, 20-52
ventilation building sites in, 4-46
visual characteristics, 9-4
Interchanges, above-grade construction for, 20-4

Interim Planning Overlay Districts (IPODs),
    Downtown IPOD, 8-2
    East Boston, 8-12
    South Boston IPOD, 8-8
Intersections,
    Central area, operation of, 3-14 to 3-15
    projected traffic operations, 3-52, 3-61
Ipswich Commuter Rail Line extension, 3-103
Irreversible and irretrievable commitment of resources, 18-1 to 18-6

Job creation, 20-36 to 20-38
Joint Development,
    Blackstone Block and, 10-10
    defined, 8-15
    historic resources and, 10-10
    overview of, 8-15
    of ventilation buildings, 8-17
Joint Development Design Guidelines, 10-5

Keany Square, 3-15, 3-69

Labor, required for construction, 20-38
Landfills,
    for clay and till, IIB 4-38 to 4-40
    identification of, IIB 4-30, IIB 4-32 to 4-34
    initial site screening of, IIB 4-50 to 4-56
    siting and management considerations, IIB 4-143 to 4-144
Landscaped areas, construction impacts, 20-86
Land use,
    affected environment, 8-1 to 8-14
    Area North of Causeway Street, 8-2 to 8-4, 8-14 to 8-15, 8-40 to 8-41
    Cambridge, 8-4
    Central Area, 8-1, 8-4 to 8-8, 8-41
    changes since FEIS/R, 8-1 to 8-2, 8-40 to 8-42
    East Boston/Logan Airport Area, 8-12 to 8-14, 8-42
    environmental consequences, 8-14 to 8-39
    Interchange Area, 8-1, 8-8 to 8-10, 8-41
    mitigation measures, 8-39 to 8-40
    overview of impacts, 8-14 to 8-15
    regional impacts, 8-16
    resolution of issues raised by public agencies, 8-42 to 8-43
    South Boston/South Boston Bypass Road Area, 8-10 to 8-12
    South Boston/South Boston Haul Road Area, 8-42
    Spectacle Island, IIB 4-83
    in study area, 7-4 to 7-5
Land use impacts,
    Area North of Causeway Street, 8-18 to 8-24
    Cambridge, 8-18 to 8-21
    CANA project, IIB 1-51

- Central Area, 8-24 to 8-27
- Charlestown, 8-18
- Chinatown, 8-27, 8-30 to 8-31
- East Boston/Logan Airport Area, 8-37 to 8-39
- Financial District, 8-26 to 8-27
- Fort Point Channel, 8-27
- Government Center, 8-26
- Interchange Area, 8-27 to 8-32
- Leather District, 8-31
- North End, 8-24 to 8-25
- North Station area, 8-21
- South Bay/Newmarket, 8-31 to 8-32
- South Boston Haul Road, IIB 2-23 to 2-24
- South Boston/South Boston Bypass Road Area, 8-32 to 8-37
- South End, 8-31
- Spectacle Island, IIB 4-124
- by subarea, 8-17 to 8-39
- Third Harbor Tunnel toll plaza locations and, IIB 3-12 to 3-13
- Waterfront/Market Area, 8-25 to 8-26
- West End, 8-24

Lead,
  in air, 4-2, 4-7
  in dredged materials, 20-73
Lead-based paint, removal from viaducts and bridges, 20-57
Leather District,
  changes since FEIS/R, 10-18
  historic impacts and mitigation, 10-13 to 10-14
  land use, 8-8, 8-31
Level of service (LOS),
  defined, 3-6
  projected, 3-24, 3-57
    Area North of Causeway Street, 3-66 to 3-67
    Central Area, 3-67 to 3-69
    East Boston/Logan Airport, 3-71 to 3-72
    Interchange Area, 3-69
    South Boston, 3-70
Leverett Circle,
  changes since FEIS/R, 3-106
  elimination of riverside ramp near, 1-7
  existing traffic operations, 3-14
  projected traffic operations, 3-57, 3-66 to 3-67
  Proposed Action description, 2-3, 2-4
Leverett Circle area,
  filled tidelands, 14-11 to 14-12
  historic impacts, 10-8
  landscaping, 14-51
  pedestrian circulation, 20-28
  Section 4(f) parkland, III 3 to 6
  visual characteristics, 9-2

Leverett Circle connector, 2-3, 2-4, IIB 1-2, IIB 1-2, IIB 1-7 to 1-10, IIB 1-13 to 1-22, IIB 1-49, IIB 1-74
  changes since FEIS/R, 9-19
  comparison of Proposed Action to FEIS/R Preferred Alternative, 2-10 to 2-11
  water quality and, 13-40 to 13-41
Lighting, for night shifts, visual impacts of, 20-86
Local streets. *See* Surface streets
Logan Airport. *See also* East Boston/Logan Airport Area
  access and egress roads, 2-9, 2-10, 2-12 to 2-13
  access to, IIB 3-2, 1-3, 3-9, 3-23 to 3-24
  air transportation, 3-21
  alternative transportation to, 3-21
  bicycling options, 3-99
  commercial vehicles (CV) only lane, 3-16
  construction activities in, 20-2
  egress route congestion, 3-95
  gateway into Boston from, visual impacts, 9-10 to 9-11
  impacts to, 3-95 to 3-96
  industrial activity and, 7-41 to 7-42
  land use, 8-12 to 8-11, 8-39
  parking supply, 3-96
  passenger and freight growth, 3-21
  pedestrian circulation, 3-98 to 3-99
  potential supplementary disposal sites, IIB 4-153 to 4-154
  roadway system, redesign of, 1-9
  Third Harbor Tunnel toll plaza, IIB 3-1 to 3-15, 2 to 13, 2 to 9
  travel to and from, 3-2, 3-4, 3-16, 3-21
  visual characteristics, 9-5
  waterborne construction rigs height limitations and, 20-33
Logan Airport North disposal site, IIB 4-79 to 4-82
  compared with other sites, IIB 4-130
  environmental impacts, IIB 4-110 to 4-113
Logan Airport West disposal site, IIB 4-82 to 4-83
  compared with other sites, IIB 4-130
  environmental impacts, IIB 4-113 to 4-115
Long-term productivity, 19-1 to 19-3
Long Wharf District, 10-11 to 10-12
Long Wharf ferry service, 3-105
Lovejoy Wharf, IIB 1-24, IIB 1-36, IIB 1-53, IIB 1-55, IIB 1-57, IIB 1-59, IIB 1-63, IIB 1-64, IIB 1-90, IIB 1-98, IIB 1-101, 3-95, 14-38
Lower Charles River. *See also* Charles River
  aquatic impacts, 14-32 to 14-34
  area description, 14-3 to 14-4
  hydrographics, 13-16, 13-32
  impacts to, IIB 1-44 to 1-47, IIB 1-69 to 1-70, IIB 1-75 to 1-78, IIB 1-96
  long-term impacts to, 14-30
  marine life, 13-23, 13-32 to 13-33
  mitigation measures, 13-39 to 13-40
  reduction in encroachment of, 13-40 to 13-41, 14-52

  removal of piers from, 13-39 to 13-40
  sediment quality, 13-17, 13-20, 13-33
  waterfront/filled tidelands, 14-11 to 14-12, 14-38 to 14-39
  water quality, 13-16 to 13-23, 13-31 to 13-33, 13-39 to 13-40
  waterways/flowed tidelands, 14-8 to 14-11, 14-34 to 14-38
  wetlands resources, 14-5 to 14-8, 14-30 to 14-32
Lynn, new commuter rail station, 3-103

McCourt Company, 20-7
Maintenance of traffic,
  in Central Area, 20-11
  during construction, 20-95 to 20-99
Maintenance of Traffic Plan, 20-20, 20-96 to 20-97. 20.98, 20-100, 20-105
Malden disposal site, IIB 4-4.61 to 4-64, IIB 4-96 to 4-99
Manufacturing, 7-12 to 7-13, 7-13, 7-51
MAPC. *See* Metropolitan Area Planning Council
Marine disposal sites, IIB 4-4, IIB 4-41 to 4-43
  comparison of, IIB 4-130
  non-ocean, IIB 4-50 to 4-56
  ocean, IIB 4-44 to 4-50
Marine industries,
  impacts on, 7-40 to 7-43
  improved access for, 14-42 to 14-43
Marine resources,
  Boston Inner Harbor, 13-13, 13-16, 13-31, 20-73 to 20-74
  construction impacts, 20-103
  Fort Point Channel, 13-8, 13-29 to 13-30
  Lower Charles River, 13-23, 13-32 to 13-33
  Massachusetts Bay Disposal Site, IIB 4-45 to 4-46
  Millers River, 13-23, 13-32 to 13-33
  Spectacle Island, IIB 4-86 to 4-87, IIB 4-121 to 4-123
Marine Sciences Research Center (MSRC) model, 20-73
Marine sediments,
  odors from, 20-93
  Spectacle Island, IIB 4-85 to 4-86, IIB 4-120 to 4-121
Marine traffic, construction impacts on, 20-32
Massachusetts, project-related revenues to, 20-45 to 20-47
Massachusetts Ambient Air Quality Standards (AAQS), 4-71
Massachusetts Avenue Interchange,
  HOV system, 2-14
  improvements to, 2-12
  projected traffic operations, 3-69
  Proposed Action description, 2-6 to 2-7
Massachusetts Bay Disposal Site (MBDS), IIB 4-21, IIB 4-41, IIB 4-44 to 4-45, IIB 4-129
  environmental impacts, IIB 4-92
Massachusetts Bay Transportation Authority (MBTA),
  Airport Blue Line station, improvements to, 2-9
  Area North of Causeway Street, IIB 1-2, IIB 1-3, IIB 1-12, IIB 1-51, IIB 1-52, IIB 1-61
  Blue Line, 10-11, 20-31

  - bus transportation, 3-94 to 3-95, 3-103
  - commuter rail facilities, 3-92 to 3-93, 3-102 to 3-103
  - Green Line, 20-31
  - new services, 3-102
  - Orange Line, 20-31
  - proposed major projects, 18-6
  - Red Line, 20-9, 20-31
  - replacement parking facility, 3-86, 3-91
  - South Boston transit alternatives study, 20-31
  - station moderization program, 3-102
  - transit changes since FEIS/R, 3-20 to 3-21
  - transit facilities, 3-92 to 3-93, 3-100 to 3-102
  - transit mitigation measures, 3-100 to 3-105
  - transit parking facility improvements, 3-104
  - transit projects, 20-30 to 20-32
  - transit stations, construction impacts, 20-87
  - transit tunnels,
    - deep excavations and, 17-12
    - protection of, 20-8, 20-31
    - vibration levels near, 5-30
- Massachusetts Dept. of Environmental Protection (DEP),
  - Area North of Causeway Street, IIB 1-43, IIB 1-45
  - identification of landfills by, IIB 4-30, IIB 4-34
  - noise guidelines, 5-25
  - Waterways Licensing Program, 14-1 to 14-2
- Massachusetts Dept. of Revenue, 7-54
- Massachusetts Executive Office of Environmental Affairs (EOEA), IIB 1-2, IIB 1-9
- Massachusetts General Hospital, 20-49
- Massachusetts Port Authority. *See* Massport
- Massachusetts State Historic Preservation Officer, 10-1
- Massachusetts Turnpike,
  - gateway into Boston from, visual impacts, 9-10
  - traffic volumes, 3-4
- Massachusetts Water Resources Authority. *See* MWRA
- Massport,
  - airport HOV system, 3-96
  - construction impacts to, 20-82
  - efforts to increase transit ridership by, 3-96
  - parking freeze amendment proposed by, 3-96
  - replacement parking programs, 3-91
  - South Boston truck route studies, IIB 2-2 to 2-4
  - Third Harbor Tunnel depth and, 7-42 to 7-43
- Massport Haul Road, IIB 2-1, 20-12, 20-24
- Materials delivery,
  - in Area North of Causeway Street, 20-19
  - in Central Area, 20-21 to 20-22
- Materials disposal program, IIB 4-1 to 4-154
  - alternative approaches, IIB 4-131 to 4-135
  - aquatic impacts, IIB 4-136, IIB 4-140

    construction impacts, IIB 4-144 to 4-145
    costs of, IIB 4-151
    environmental impact comparisons, IIB 4-127 to 4-152, IIB 4-135 to 4-145
    federal and state regulations governing, IIB 4-4 to 4-5
    long-term impacts, IIB 4-36
    material quality, IIB 4-16 to 4-27
    material quantities, IIB 4-15 to 4-16
    objectives of, IIB 4-1
    planning considerations, IIB 4-36
    Proposed Action, IIB 4-152 to 4-153
    public open space impacts, IIB 4-141
    purpose of, IIB 4-1
    regulations affecting, IIB 4-46 to 4-49
    requirements for, IIB 4-1 to 4-3
    short-term impacts, IIB 4-36
    water supply impacts, IIB 4-140
    wildlife impacts, IIB 4-140 to 4-141
Materials movement,
    construction impact changes since FEIS/R, 20-100
    options for, IIB 4-7 to 4-15
MBTA. *See* Massachusetts Bay Transportation Authority
Memorandum of Agreement (MOA), 10-1
    construction impacts and, 20-88
    Gridley Street District and, 10-12
    mitigating measure stipulations, 10-5
    Russia Wharf and, 10-13
    ventilation building stipulations, 10-16
Metropolitan Area Planning Council (MAPC), 7-1
    area forecasts, 7-2, 7-26, 7-30
Metropolitan District Commission,
    Area North of Causeway Street plans, IIB 1-2, IIB 1-3, IIB 1-52 to 1-56, IIB 1-98 to 1-100
    Charles River Esplanade plans, IIB 1-3
Midtown/Retail District, economic activity in, 7-23
Millers River,
    aquatic impacts, 14-32 to 14-34
    area description, 14-4 to 14-5
    construction impacts, 20-8 to 20-81
    filling, 20-80
    floodplain encroachment, 15-12, 15-13
    hydrographics, 13-16, 13-32
    impacts to, IIB 1-45 to 1-47, IIB 1-69
    increase in filling of, 13-41
    inland wetland resource areas, 20-80 to 20-81
    long-term impacts to, 14-30
    marine life, 13-23, 13-32 to 13-33
    sediment quality, 13-23, 13-33
    visual impacts, 9-8
    waterfront/filled tidelands impacts, 14-38 to 14-39

  - water quality, 13-16 to 13-23, 13-31 to 13-33, 13-41
  - waterways/flowed tidelands impacts, 14-34 to 14-38
  - wetlands mitigation, 14-49
  - wetlands resources, 14-5 to 14-8, 14-30 to 14-32
- Mill Pond Wharf site, 11-13, 11-14
  - Section 4(f) evaluation, III 43
- Mitigation measures,
  - CANA project, IIB 1-98 to 1-100
  - construction activities, 20-1, 20-93 to 20-99
  - maintenance of traffic, 20-95 to 20-99
  - noise, 5-25 to 5-30
  - Option 5A Modified, IIB 1-99
  - Option S Modified, IIB 1-99
  - Option T Modified, IIB 1-99
  - Option Z Modified, IIB 1-99, IIB 1-101
  - Paul Revere Landing Park, IIB 1-97 to 1-101
  - Spectacle Island, IIB 4-125 to 4-126
  - tourism, 20-48
  - transportation, 3-99 to 3-106
  - visual impacts, 9-17 to 9-19
  - water quality, 13-39 to 13-40
  - wetlands and waterways, 14-49 to 14-51
- Mitigation planning, 20-94 to 20-95
- Mitigation Program Office, 20-14, 20-15 to 20-16, 20-94
- Mobile source emissions, 4-69 to 4-70, 20-53 to 20-54
- Motorists, visual experiences of, 9-8 to 9-12, 9-14 to 9-15, 20-88
- Movement monitoring, 20-8 to 20-9
- MWRA,
  - Boston Harbor cleanup project, barge traffic for, 20-36
  - disposal sites, IIB 4-28, IIB 4-30, IIB 4-32, IIB 4-50 to 4-56
  - Residuals Management Facilities Plan, IIB 4-28, IIB 4-30, IIB 4-52

- 100 Nashua Street, IIB 1-2, IIB 1-66, IIB 1-67, IIB 1-80, 10-8, 10-17
- Nashua Street Park, IIB 1-1, IIB 1-3, IIB 1-53 to 1-54, IIB 1-60, IIB 1-71, IIB 1-92, IIB 1-96 to 1-98, IIB 1-101
- Nashua Street parkland, Section 4(f) evaluation, III 6 to 7
- National Ambient Air Quality Standards (AAQS), 4-71
- National Register of Historic Places, 10-1, 11-1 to 11-14
- Navigation,
  - Boston Inner Harbor, 14-24, 14-29, 14-48
  - Charles River, 14-8 to 14-11, 14-34, 14-38
  - construction impacts, 20-32 to 20-36
  - Fort Point Channel, 14-15 to 14-16, 14-42
  - mitigation measures, 20-98
  - Third Harbor Tunnel and, 7-42 to 7-43
- NECMA. *See* New England County Metropolitan Area
- Neighborhoods,
  - Cambridge, 8-21
  - Charlestown, 8-18

    Chinatown, 8-30 to 8-31
    East Boston, 8-37 to 8-39
    Financial District, 8-27
    Fort Point Channel, 8-27
    Government Center, 8-26
    land use impacts, 8-15
    Leather District, 8-31
    North End, 8-24 to 8-25
    North Station, 8-21
    South Bay/Newmarket, 8-32
    South Boston, 8-37
    South End, 8-31
    Waterfront/Market Area, 8-25 to 8-26
    West End, 8-24
Neptune Lobster, construction impacts to, 20-83
New Bedford/Fall River Commuter Rail extension, 3-103
New Boston Garden development, IIB 1-6, IIB 1-50 to 1-52, IIB 1-94
New East Side Interceptor, 12-4
New England Aquarium, 20-82
New England County Metropolitan Area (NECMA), 7-1
    construction impacts, 20-36 to 20-42
    employment in, 7-1 to 7-2, 7-36 to 7-37
    growth forecasts, 7-1 to 7-2, 7-26 to 7-28
    industrial/manufacturing space in, 7-13
New England Medical Center, 20-49
New England Telephone Company, utility relocations, 12-12
Newmarket,
    economic impacts, 7-42
    land use impacts, 8-31 to 8-32
New Market Industrial District, 8-10
Nitrogen oxides (NO_x), 4-2, 4-3, 4-5 to 4-6
    mesoscale analysis, 4-10, 4-15
    projected, 4-21, 4-29
    State Implementation Plan and, 4-60
    ventilation building emissions, 4-48
Noise,
    affected environment, 5-1 to 5-2
    ambient levels, 5-1 to 5-2
    changes since FEIS/R, 5-29 to 5-30, 20-105
    construction impacts, 20-59 to 20-63, 20-103
    environmental consequences, 5-2 to 5-25
    mitigation measures, 5-25 to 5-29, 20-102
    projected, 5-15 to 5-16
    resolution of issues raised by public agencies, 5-36
    short-term impacts and long-term productivity, 19-1
    Spectacle Island, IIB 4-90 to 4-91
    traffic, 5-2 to 5-23
    tunnel portals, 5-25
    ventilation, 5-23 to 5-25

Noise abatement criteria (NAC), 5-2, 5-16, 5-23, 20-59 to 20-61
Noise barriers, 5-26 to 5-29
  Area North of Causeway Street, 5-26 to 5-27
  Central Area, 5-27 to 5-28
  East Boston/Logan Airport Area, 5-29
  I-93/I-90 and Massachusetts Avenue Interchange Area, 5-28
  South Boston/South Boston Bypass Road Area, 5-29
Noise impacts,
  Paul Revere Landing Park, IIB 1-44
  South Boston Haul Road, IIB 2-20 to 2-23
  Spectacle Island, IIB 4-125
  stockpile sites, IIB 4-40
  Third Harbor Tunnel toll plaza locations, IIB 3-10 to 3-12
North End,
  archaeological resources, 11-3 to 11-14
  land use, 8-4, 8-7, 8-15, 8-24 to 8-25, 8-41
  pedestrian circulation, 9-13
  retail district, 7-12, 7-38, 7-39 to 7-40
  as tourist destination area, 7-47
  visual impacts, 9-13
North End District, 10-10 to 10-11, 10-18
North Point, Cambridge, IIB 1-3, IIB 1-6, IIB 1-50, IIB 1-61
  filled tidelands, 14-12, 14-39
  land use changes, 8-4, 8-21
  noise barrier analysis for, 5-27
  visual impacts, 9-8
North Station, IIB 1-1 to 1-3, IIB 1-6 to 1-15, IIB 1-24, IIB 1-50 to 1-52, IIB 1-71 to 1-79, IIB 1-84, IIB 1-89 to 1-92, IIB 1-95, IIB 1-96, IIB 1-98, 3-94, 3-103, 7-35
North Station area,
  development, IIB1-2 to 1-3
  economic activity, 7-20, 7-23
  filled tidelands, 14-11 to 14-12, 14-38 to 14-39
  land use, 8-2, 8-21, 8-40 to 8-41
  movement of excavated materials by rail in, IIB 4-9
  pedestrian circulation, 3-97
  replacement parking facility, 3-86. 3.91
  visual characteristics, 9-2
Notice of Project Change, for Area North of Causeway Street area, IIB1-2
Nuisance abatement, 20-89 to 20-93, 20-104
  cockroach mitigation, 20-93
  mitigation measures, 20-104
  odor control, 20-93
  rodent control, 20-89 to 20-93

O'Brien Highway, existing traffic operations, 3-14
Ocean disposal,
  of excavated materials, IIB 4-6
  of floating materials, IIB 4-47 to 4-50
  regulations for, IIB 4-46 to 4-49

Ocean Dumping Regulations, IIB 4-46 to 4-49
Odor control, 20-93, 20-104
Office market,
    construction impacts on, 20-42 to 20-43
    growth in, 3-2
    impacts on, 7-34 to 7-37, 7-51
    projected, 7-30, 7-35 to 7-36, 20-42
    property values, 20-42 to 20-43
    in study area, 7-9
    vacancy rates, 20-43
Oil,
    in soils, IIB 4-19, IIB 4-25
    in tunnel-generated wastewater, 13-33 to 13-34
Old Colony Commuter Rail extension, 3-102 to 3-103
Old Colony Railroad Bridge, 10-15, 10-17
Oliver/Purchase Streets District, 10-12, 10-18
Option 5A Modified, IIB 1-1, IIB1-1, IIB 1-2, IIB 1-4, IIB 1-7. *See also* Preferred Alternative of FEIS/R
    comparison of options, IIB 1-84 to 1-97
    construction impacts, IIB 1-68 to 1-72
    description, IIB 1-8 to 1-10
    design issues, IIB 1-79
    long-term impacts, IIB 1-38 to 1-47, IIB 1-49 to 1-51, IIB 1-53 to 1-67
    mitigation measures, IIB 1-99
    Section 4(f) parkland and, III 2 to 12, III 2 to 3
    traffic operations, IIB 1-18, IIB 1-19, IIB 1-23 to IIB 1-37
Option S Modified, IIB 1-7
    comparison of options, IIB 1-83 to IIB 1-97
    construction impacts, IIB 1-68 to 1-71, IIB 1-73
    description, IIB 1-10 to 1-12
    design issues, IIB 1-80 to 1-83
    long-term impacts, IIB 1-38 to 1-51, IIB 1-53 to 1-67
    mitigation measures, IIB 1-99
    Section 4(f) parkland and, III 2 to 13
    traffic operations, IIB 1-19, IIB 1-20, IIB 1-23, IIB 1-25, IIB 1-27 to 1-37
Option T Modified, IIB 1-7
    comparison of options, IIB 1-84 to 1-97
    construction impacts, IIB 1-67 to 1-71, IIB 1-73 to 1-75
    description, IIB 1-12 to 1-14
    design issues, IIB 1-80 to 1-83
    long-term impacts, IIB 1-37 to 1-66
    mitigation measures, IIB 1-99
    Section 4(f) parkland and, III 13, III 16, III 2 to 11
    traffic operations, IIB 1-20 to 1-23, IIB 1-25, IIB 1-27 to 1-36
Option Z Modified,
    comparison of options, IIB 1-84 to 1-97
    construction impacts, IIB 1-68 to 1-71, IIB 1-75
    description, IIB 1-8, IIB 1-14, IIB 1-15
    design issues, IIB 1-81 to 1-83

  long-term impacts, IIB 1-37 to 1-50, IIB 1-52 to 1-66
  mitigation measures, IIB 1-99, IIB 1-101
  Section 4(f) parkland and, III 2 to 11, III 16 to 17
  traffic operations, IIB 1-21 to 1-24, IIB 1-26 to 1-36
Ozone (O_3), 4-2, 4-3, 4-5 to 4-6

Paddy's Alley site, III 43, 11-13, 11-14
Pagoda Park, III 31
Parcel 7,
  historic resources impacts, 10-18
  parking garage, 3-86, 3-91
Parking,
  construction impacts, 20-17
  displaced, 3-86 to 3-91, 20-48 to 20-49
  existing facilities, 3-19
  hospitals and, 20-49 to 20-50
  improvements in, 7-56
  at Logan Airport, 3-96
  replacement, 3-86 to 3-91, 7-48
  tourism and, 7-48
  for transit facilities, 3-104
Parking Freeze, 3-19
  Logan Airport and, 3-96
  proposed modification of, 3-105
Parking restrictions, improvments in since FEIS/R, 3-3 to 3-4
Parking supply managment, as mitigation measure, 3-105
Parklands and open space. *See also* specific parklands
  CANA project, IIB 1-57
  construction impacts to, 20-88
  increases in, 1-7 to 1-8, 18-2
  materials disposal program impacts, IIB 4-141
  Section 4(f) evaluation, III 1 to 34
  short-term use of, 19-13
Particulate matter, 4-2, 4-3
Passenger ferry services, 20-36
Paul Revere Landing Park, IIB 1-1, IIB 1-2, IIB 1-3
  comparison of Options, IIB 1-88, IIB 1-89, IIB 1-92, IIB 1-94
  construction impacts, IIB 1-71, 20-86
  design issues, IIB 1-82
  filled tidelands impacts, 14-39
  land use, 8-18, 8-21, 8-39 to 8-40
  mitigation measures, IIB 1-97 to 1-101
  noise barrier analysis, 5-27
  noise impacts, IIB 1-44
  parkland impacts, IIB 1-52 to 1-57
  pedestrian circulation, 3-97
  Section 4(f) parkland, III 7 to 11
  visual impacts, IIB 1-58, IIB 1-59, IIB 1-62, 9-7 to 9-8
  wetlands and waterways mitigation, 14-51

Peak hour traffic counts, 3-4
Peak hour traffic volumes, 3-39 to 3-52
Peak vibration velocity, 5-31
Pedestrian circulation,
    Area North of Causeway Street, 3-97
        during construction, 20-27 to 20-28
    Central Area, 3-97 to 3-98
        during construction, 20-28 to 20-29
        visual characteristics, 9-3 to 9-4
    Central Artery corridor, visual impacts, 9-13 to 9-14
    Charles River area, visual impacts, 9-7 to 9-8
        construction period mitigation measures, 20-100
        during construction, 20-27 to 20-30
    East Boston/Logan Airport Area, 3-98 to 3-3 to 99
        during construction, 20-29
        existing, 3-21 to 3-22
        impacts on, 3-96 to 3-99
    Interchange Area, 3-98
        during construction, 20-28
    South Boston, 3-98
        during construction, 20-28 to 20-29
    South Boston Haul Road and, IIB 2-17
        survey of, 3-22
    Third Harbor Tunnel area, 3-98
        during construction, 20-29
        visual experiences of, during construction, 20-88
        visual impacts mitigation, 9-19
Pest control. *See* Cockroach mitigation; Rodent control
Pile driving, vibration and, 20-67 to 20-69
Pine Street Inn, 20-48
Plants, construction impacts to, 20-82
PM peak hour intersection operations, 3-61
PM peak hour speeds, 3-53, 3-57
PM peak hour traffic volumes, 3-39 to 3-52
Population,
    forecasts, 7-26 to 7-30
    regional, growth since FEIS/R, 7-1 to 7-2
    of study are, 7-4
Port facilities, long-term benefits, 19-2
Porzio Park, III 33 to 34
Preferred Alternative of FEIS/R. *See also* Option 5A Modified
    for Area North of Causeway Street, IIB1-1
    modification of, 1-3
    Proposed Action and, 2-1, 2-10 to 2-15
    selection of, 1-3
Preliminary engineering, construction management during, 20-13
Productivity, long-term, 19-1 to 19-3
Project Conservator, 10-4 to 10-5, 20-88 to 20-89
Project Mitigation Program Office, 20-106

Property taxes, effect of construction on, 20-43
Property values, office, impact of construction on, 20-42 to 20-43
Proposed Action,
  archaeological resources, 11-1 to 11-15
  consistency with local plans, 8-16
  construction activity, 20-1 to 20-106
  defined, 2-1
  description by subarea, 2-2 to 2-10
  economic characteristics, 7-1 to 7-57
  energy analysis, 6-1 to 6-5
  FEIS/R Preferred Alternative and, 2-1, 2-10 to 2-15
  floodplain impacts, 15-1 to 15-13
  increased capacity of, 3-1
  irreversible and irretrievable commitment of resources, 18-1 to 18-6
  land use and neighborhood characteristics, 8-1 to 8-43
  noise impacts, 5-1 to 5-30
  purpose and need of, 1-4 to 1-5
  regulatory framework for, 1-10
  resolution of issued raised by public agencies, 2-16
  short-term impacts and long-term benefits, 19-1 to 19-13
  southern project limits of, 2-11
  traffic operations improvements with, 3-23 to 3-24
  transportation impacts, 3-1 to 3-108, 3-23 to 3-24
  utility impacts, 12-1 to 12-15
  vegetation and wildlife impacts, 16-1 to 16-12
  visual characteristics, 9-1 to 9-21
Public education, on rodent control, 20-91
Public involvement. *See* Community participation
Public open space, materials disposal program impacts, IIB 4-141
Public transit,
  bus improvements, 3-103
  changes since FEIS/R, 3-20 to 3-21
  commuter rail improvements, 3-102 to 3-103
  construction impacts to, 20-30 to 20-32
  construction period mitigation measures, 20-100
  existing, 3-20 to 3-21
  HOV system, 3-104 to 3-105
  improvements in, 1-6
  Logan Airport traffic and, 3-96
  MBTA facilities, impact on, 3-92 to 3-93
  as mitigation measures, 3-100 to 3-101, 3-100 to 3-105
  new services, 3-102
  rapid transit improvements, 3-100 to 3-102
  ridership, impacts on, 3-91 to 3-92
  service improvements, 7-56
  temporary access during construction, 20-87
  transit parking facilities, 3-104
  water transportation, 3 to 105

Quincy Market, noise barrier analysis for, 5-28

Radial highways, 3-2
Railroad, movement of excavated materials by, IIB 4-8 to 4-10
Ramps,
  accident rates and, 3-85
  changes since FEIS/R, 3-106 to 3-107
  existing, 3-14
  projected traffic operations, 3-57
    Area North of Causeway Street, 3-66 to 3-67
    Central Area, 3-67
    East Boston/Logan Airport, 3-71
    Interchange Area, 3-69
  South Station Transportation Center (SSTC), 3-94
Rapid Service Press building, 20-48
Raw materials, consumption of, for project, 18-1 to 18-2
Real estate development, Proposed Action and, 18-6
Regional Economic Models, Inc. (REMI) Model, 7-33 to 7-34, 7-35, 7-51, 20-36 to 20-38
Regional land use impacts, 8-16
Regional sales, changes in construction impacts since FEIS/R, 20-101
Regulatory requirements, 1-10
Reinforced concrete immersed tube, construction activities, 20-3 to 20-4
Relocation, 8-14, 8-15 to 8-16
  costs of, 20-38
  for South Boston Haul Road, IIB 2-24
Relocation impacts, Area North of Causeway Street, IIB 1-63 to 1-65
Rental property, residential, 7-18
Replacement parking, 3-86 to 3-91
  construction and, 20-17
  downtown Boston, 3-86, 3-91
  East Boston, 3-91
  Interchange Area, 3-91
  project impacts, 3-86
  South Boston, 3-91
Resident engineers, 20-15
Residential space,
  construction impacts, 20-45
  impacts on, 7-43 to 7-44
  in study area, 7-13 to 7-18
  vacancy rates, 7-18
Residuals management facilities, identification of, IIB 4-28, IIB 4-30
Resources, irreversible and irretrievable commitment of, 18-1 to 18-6
Retail business,
  construction impact changes since FEIS/R, 20-101
  construction impacts on, 20-43 to 20-44
  customer base, 7-38
  districts, 7-12, 7-39 to 7-40
  highway-related, 20-44

    impacts on, 7-37 to 7-40, 7-51, 20-38 to 20-42
    overall sales, 7-37 to 7-39
    in study area, 7-9 to 7-12
    takings of, 20-45
    turnover of, 20-43 to 20-44
Retaining walls, visual impacts of, 20-85
Roadway network. *See* Highway and street network
Roadway support facilities consumption, 6-1, 6-3
Rodent baiting, 20-91 to 20-92
Rodent control, 20-89 to 20-93
    construction impact changes since FEIS/R, 20-104
Rodenticides, 20-91 to 20-92
Rodent-proofing, 20-91
Rotch Playground, III 31
    noise barrier analysis for, 5-28
    noise impacts, IIB 2-20 to 2-23
Route 1, gateway into Boston from, visual impacts, 9-9
Route 1A,
    changes since FEIS/R, 3-108
    gateway into Boston from, visual impacts, 9-10 to 9-11
    projected traffic operations, 3-71 to 3-72
    ramping system, restricted operations on, 3-16
    reconstruction of, 2-9
Rowes Wharf,
    commuter boat service, 3-105
    visual impacts to, 9-13
Roxbury Canal Conduit, 13-2, 14-14
Runoff, from construction areas, 20-81
Russia Wharf, 10-13, 10-18

Safety. *See* Traffic safety
Sanitary waste landfills. *See* Landfills
Sanitation, during construction, 20-90 to 20-91
Screenline crossings, analysis of, 3-39
Seaport Access Road, 2-1
    changes since FEIS/R, 8-42
    Fort Point Channel dredging for, 20-76
    historic resources impacts, 10-15
    land use impacts, 8-32
    need for, IIB 2-3
    Proposed Action description, 2-8
    purpose of, 2-2
    Section 4(f) resources and, III 38, III 40
    South Boston Bypass Road connection with, IIB 2-1
    tunnel under Fort Point Channel, 13-26 to 13-30
    visual impacts of tunnel, 9-11 to 9-12
Seaport-related business, impacts on, 7-41

Seawater users,
    construction impact changes since FEIS/R, 20-103
    Fort Point Channel, 20-78, 20-82
    impacts to, 13-23, 13-52 to 13-53, 20-82
Section 4(f) evaluation, III 1 to 45
    archaeological resources, III 42 to 44
    Area North of Causeway Street, III 2 to 21
    Causeway/North Washington Street Historic District, III 36 to 38
    Charles River Basin Historic District, III 35 to 36
    coordination, III 44 to 45
    East Boston Memorial Stadium Park, III 22 to 27
    Fort Point Channel Historic District, III 38 to 42
    historic resources, III 34 to 42
    Leverett Circle/Storrow Drive, III 3 to 6
    MDC parkland at former GSA site, III 7
    Nashua Street parkland, III 6 to 7
    parklands, III 1 to 34
    Paul Revere Landing Park, III 7 to 11
    Spectacle Island, III 27 to 30
Section design consultant (SDC) contracts, 20-13 to 20-14
Sediment quality,
    Boston Inner Harbor, 13-13, 13-31
    Fort Point Channel, 13-7 to 13-8, 13-30
    Lower Charles River, 13-17, 13-33
    Millers River, 13-23, 13-33
Sediments, odors from, 20-93
Sewage, project-generated, 13-34 to 13-35, 13-41
Sheet piling, vibration and, 20-67
Shipping channel,
    40-foot depth of, 14-48
    Third Harbor Tunnel and, 7-42 to 7-43
Short-term uses of the environment, 19-1 to 19-13
Signs, temporary, during construction, 20-87
Siltation, short-term impacts and long-term productivity, 19-12
Slurry wall construction, vibration and, 20-67 to 20-69
Soil characterization program, IIB 4-16, IIB 4-21, IIB 4-24 to 4-27
Soils and geology, 17-1 to 17-12
    affected environment, 17-1 to 17-12
    environmental consequences, 17-12
    mitigation measures, 17-12
South Bay/Fort Point Channel area, ventilation building constriants in, 4-44
South Bay interchange, parking spaces displaced in, 20-17
South Bay/Newmarket,
    industrial/manufacturing space in, 7-13
    land use, 8-10, 8-31 to 8-32
South Boston,
    barge loading facilities, 20-25, 20-35
    commuter traffic through, 3-16
    construction activities in, 20-2

  - construction materials movement in, 20-24 to 20-25
  - construction traffic impacts, 20-24 to 20-25
  - construction work areas, 20-25
  - economic activity, 7-23, 7-25
  - excavated materials movement in, 20-5
  - excavated materials removal from, IIB 4-15
  - existing traffic operations, 3-16
  - historic resources, 10-15 to 10-17
  - improved access to marine industries in, 14-42 to 14-43
  - industrial activity, 7-13, 7-23, 7-25, 7-42
  - IPOD, 8-8
  - land use impacts to, 8-32 to 8-37
  - MBTA transit alternatives study, 20-30
  - movement of excavated materials by rail in, IIB 4-9 to 4-10
  - office space projections, 20-43
  - parking spaces displaced in, 20-17
  - parking supply in, 3-19
  - parkland, III 34, III 32 to 33
  - projected office space, 7-35
  - projected peak hour traffic volumes, 3-52
  - projected traffic operations, 3-70
  - projected traffic volumes, 3-36, 3-39
  - projected truck traffic, 3-75, 3-84
  - realignment in, 1-8
  - replacement parking in, 3-91
  - residential impacts, 7-43
  - residential space, 7-13, 7-18
  - temporary bridges in, 20-87
  - Third Harbor Tunnel toll plaza location, IIB 3-1 to 3-15
  - truck route in, IIB 2-2 to 2-6, 1-8
  - truck traffic, 3-16, 3-17
    - South Boston Bypass Road and, IIB 2-4 to 2-6, IIB 2-8, IIB 2-10, IIB 2-11
  - underpinning and bracing in, 20-8
  - utility relocation, 20-52
  - ventilation buildings, 4-46
  - vibration impacts, 20-69
- South Boston Bypass Road, 2-1, 3-24, IIB 2-1 to 2-27
  - added since FEIS/R, 8-42
  - addition of, to project, 2-12
  - air quality impacts, IIB 2-17 to 2-20
  - alternatives, IIB 2-5 to 2-6
  - alternatives analyzed, IIB 2-6 to 2-10
  - background of, IIB 2-2 to 2-6
  - changes since FEIS/R, 3-107 to 3-108
  - comparison of alternatives, IIB 2-26 to 2-27
  - design modifications considered, IID.3
  - early truck route studies, IIB 2-2 to 2-3
  - economic impacts, IIB 2-25 to 2-26
  - environmental issues, IIB 2-17 to 2-23

- HOV system, 2-15
- I-93/I-90 ramp connections, IIB 2-13, IIB 2-17
- impact assessment, IIB 2-10 to 2-26
- intersection level of service, IIB 2-13
- land use impacts, IIB 2-23 to 2-24
- land use impacts of, 8-32, 8-37
- noise impacts, IIB 2-20 to 2-23
- pedestrian circulation and, 3-98
- projected daily traffic volumes, 3-36
- projected truck traffic, 3-84
- project objectives, evaluation in terms of, IIB 2-7 to 2-10
- Proposed Action description, 2-8, IIB 2-8 to 2-10
- purpose of, 2-2, IIB 2-1 to 2-2
- relocation impacts, IIB 2-24
- selection of, IIB 2-6
- selection of proposed action, IIB 2-26 to 2-27
- South Boston Haul Road as alternative to, IIB 2-7 to 2-8
- traffic/transportation impacts, IIB 2-10 to 2-17
  - highway operations, IIB 2-11 to 2-13
  - I-93/I-90 ramp connec, IIB 2-13, IIB 2-17
  - intersection level of service, IIB 2-13
  - pedestrians and bicycles, IIB 2-17
  - traffic volumes, IIB 2-10 to 2-11
- truck bypass alternatives (1987), IIB 2-4 to 2-5
- truck route alternatives (1980), IIB 2-3 to 2-4
- visual impacts, IIB 2-24 to 2-25
- water quality impacts, IIB 2-23
- weaving operations, IIB 2-11 to 2-13

South Boston Haul Road, IIB 2-1, 20-24, 20-25 to 20-26
- air quality impacts, IIB 2-17 to 2-20
- background of, IIB 2-2 to 2-6
- construction of, 20-10, 20-12
- economic impacts, IIB 2-25
- highway operations on, IIB 2-11 to 2-17
- land use impacts, IIB 2-24
- need for, IIB 2-2, 2-4
- noise impacts, IIB 2-20 to 2-23
- permanent, IIB 2-7 to 2-8
- projected truck traffic, 3-84
- Proposed Action, IIB 2-5
- relocation impacts, IIB 2-24
- summary of impacts, IIB 2-26 to 2-27
- visual impacts, IIB 2-25
- water quality impacts, IIB 2-23

South Boston Piers/Fort Point Channel transit alternatives, 3-102, 18-6

South Boston/South Boston Bypass Road Area,
- compared with FEIS/R, 2-12
- construction impacts, public transportation, 20-31
- construction materials movement in, 20-26

  - construction traffic impacts, 20-26
  - construction work areas for, 20-26
  - design modifications considered, IID.2 to 3
  - existing facilities, 2-8
  - land use, 8-10 to 8-12, 8-32 to 8-37, 8-42
  - noise barrier analysis, 5-29
  - Proposed Action description, 2-7 to 2-8
  - proposed major traffic movements, 2-8
  - truck traffic in, 2-8
  - visual characteristics, 9-5
  - existing environment, 9-4 to 9-5
- South Boston/South Boston Haul Road Area,
  - economic activity changes since FEIS/R, 7-23, 7-25
  - pedestrian circulation, 3-98
  - pedestrian circulation during construction, 20-28 to 20-29
  - transportation analysis changes since FEIS/R, 3-107 to 3-108
- South Boston/South Boston Haul Road/Bypass Road, construction scheduling and sequencing, 20-12
- South Cove,
  - land use changes in, 8-8
  - retail impacts, 7-38, 7-40
- Southeast Expressway,
  - defined, 2-1
  - gateway into Boston from, visual impacts, 9-10
  - projected traffic operations, 3-53, 3-57, 3-60, 3-72
  - traffic operations, 3-4, 3-10, 3-15 to 3-16
- South End,
  - economic impacts on, 7-42
  - land use, 8-8 to 8-10, 8-31
- South End Industrial District, historic resources impacts, 10-15
- South Station area, movement of excavated materials by rail in, IIB 4-9
- South Station Headhouse, 10-13, 10-18
- South Station Transportation Center (SSTC),
  - impacts to, 3-94
  - improvements to, 3-103
- Spaulding Rehabilitation Hospital, 5-31, 20-49
- Spectacle Island, 1-2, 1-8
  - adjacent land use, IIB 4-90
  - air quality, IIB 4-90, IIB 4-125
  - aquatic impacts, IIB 4-136, IIB 4-140
  - aquatic resources, IIB 4-87 to 4-89
  - archaeological resources, III 43, IIB 4-91, IIB 4-124
  - Boston Harbor Islands State Park plan for, III 28 to 29, IIB 4-115 to 4-116, IIB 4-141
  - creation of additional land on, 18-1
  - cultural resources, IIB 4-91
  - disposal approaches using, IIB 4-132 to 4-135, IIB 4-146 to 4-147, IIB 4-149, IIB 4-151, IIB 4-152
  - for disposal of unacceptable dredged materials, IIB 4-43
  - ecological overview, IIB 4-126 to 4-127

  - environmental impacts, IIB 4-115 to 4-127, IIB 4-146 to 4-147, IIB 4-149 to 4-151
  - existing conditions, III 27, IIB 4-83 to 4-91
  - final elevation of, IIB 4-116
  - floodplains, IIB 4-90, IIB 4-124
  - historic resources, III 28, IIB 4-124
  - hydrographics, IIB 4-84 to 4-86, IIB 4-118 to 4-121
  - landfill policy and, IIB 4-143
  - land use and social impacts, IIB 4-124
  - long-term benefits to, 19-13
  - marine habitats, IIB 4-121 to 4-123
  - marine life, IIB 4-86 to 4-87
  - marine sediment quality, IIB 4-85 to 4-86, IIB 4-120 to 4-121
  - material containment facility design, IIB 4-115 to 4-118
  - mitigation measures, IIB 4-125 to 4-126
  - vs. multiple inland disposal sites, IIB 4-6 to 4-7
  - natural resources, III 27 to 28
  - noise and vibration, IIB 4-90 to 4-91, IIB 4-125
  - public open space impacts, IIB 4-141
  - Section 4(f) resources, III 43, III 27 to 30
  - short-term use of, 19-13
  - site description, IIB 4-83 to 4-84
  - terrestrial habitats, IIB 4-123 to 4-124
  - tidelands, IIB 4-125
  - topography, geology, and soils, IIB 4-84, IIB 4-118
  - vegetation and wildlife, IIB 4-89 to 4-90
  - visual features, IIB 4-91, IIB 4-124
  - water quality, IIB 4-85, IIB 4-119 to 4-120
  - wetlands displacement near, 18-2
  - wildlife, IIB 4-121 to 4-124, IIB 4-141
- Spills,
  - in construction areas, 20-81
  - construction impact changes since FEIS/R, 20-103
- State Implementation Plan (SIP), 4-71
- State taxes, impacts on, 7-54 to 7-56
- Stationary source emissions, construction impacts, 20-54 to 20-59
- Steel shell immersed tube, construction, 20-3, 20-12
- Stockpile sites, for excavated materials, IIB 4-40
- Stop & Shop Building, IIB 1-50, IIB 1-63, IIB 1-64, IIB 1-66
  - land use changes and, 8-21
  - loading dock relocation, 10-5
- Stormwater,
  - impacts of, 13-36 to 13-39, 13-41
  - mitigation measures, 13-40
- Storrow Drive,
  - gateway into Boston from, visual impacts, 9-9
  - traffic volumes, 3-4
- Storrow Drive connection, IIB 1-9, IIB 1-10, IIB 1-11, IIB 1-14, IIB 1-17, IIB 1-50
- Streetcar Tunnel, historic impacts and mitigation, 10-11

Street direction changes, as mitigation measures, 3-106
Study area,
    accessibility of, 7-20
    defined, 7-2 to 7-4
    economic forecasts for, 7-26 to 7-30
    employment in, 7-4 to 7-5
    existing and projected trips in, 3-27
    industrial/manufacturing space in, 7-12 to 7-13
    land use survey of, 7-4 to 7-5
    office space in, 7-9
    population of, 7-4
    residential space in, 7-13 to 7-18
    retail space and trade in, 7-9 to 7-12
    tourism and hotel space in, 7-18 to 7-20
    traffic operations in, 3-6 to 3-10
Subsurface easements, taken for right-off-way, 18-1
Suffolk County,
    construction impacts on, 20-38
    economics, 7-1, 7-28, 7-51
    long-term tourism losses, 7-50
    residential space, 7-13, 7-18
    retail sales projections, 7-39
Sulfur oxides (SOx), 4-2, 4-3
Summer Street Bridge, 10-16, 10-17
Sumner Tunnel, 3-3
    airport traffic and, 3-21
    projected congestion in, 3-72, 3-95
    projected traffic operations, 3-53, 3-71
    projected traffic volumes, 3-27, 3-39
    traffic operations, 3-4, 3-10
Surface Artery,
    projected pedestrian circulation, 3-97
    projected traffic operations, 3-68 to 3-69
    traffic operations, 3-15
Surface construction, 20-4
Surface land, taken for right-off-way, 18-1
Surface streets, 2-12
    capacity of, 3-6
    in Central Area, rebuilding of, 2-4 to 2-5
    deficiencies of, 3-14 to 3-15
    design modifications considered, IID.3
    in Interchange Area, 2-6
    motorists on, 9-14 to 9-15
    projected traffic operations, 3-36 to 3-39, 3-52, 3-61, 3-66
    visual impacts to, 9-12 to 9-15
Surface water, changes in construction impacts since FEIS/R, 20-103

Taxes,
    impacts on, 7-54 to 7-56
    project impacts on revenues, 20-45 to 20-47
    property, effect of construction on, 20-43
Temporary public transportation access, during construction, 20-87
Temporary signs, during construction, 20-87
Temporary structures, during construction, visual impacts of, 20-87
Terrestrial habitats, Spectacle Island, IIB 4-123 to 4-124
Terrestrial plants, construction impacts to, 20-82
Third Harbor Tunnel, 2-1
    alignment improvements, 2-12
    backfilling, 20-35
    Boston Inner Harbor water quality and, 13-30 to 13-31
    construction impacts on navigation, 20-33 to 20-35
    construction scheduling and sequencing, 20-12
    construction work areas for, 20-25
    depth of, 7-42 to 7-43
    dredged materials removal from, IIB 4-11
    HOV system and, 2-14, 2-15, 3-105
    immersed tube tunnel placement, 20-34 to 20-35
    Logan Airport traffic and, 3-95 to 3-96
    navigation impacts, 7-42 to 7-43, 20-33 to 20-35
    pedestian circulation and, 3-98
    projected traffic operations, 3-71
    purpose of, 2-2
    scheduling of construction of, 20-10
    steel immersed tube construction, 2-12
    toll plaza locations, IIB 3-1 to 3-15, 2-9, 2-13
        air quality impacts, IIB 3-9 to 3-10
        alternatives analysis, IIB 3-5 to 3-15
        background, IIB 3-2
        carbon monoxide levels near, 4-41
        changes since FEIS/R, 3-108
        description, IIB 3-4 to 3-5
        design objectives, IIB 3-1 to 3-2
        environmental issues, IIB 3-10 to 3-12
        HOV systems and, IIB 3-2, IIB 3-3, IIB 3-9
        incident management, IIB 3-7 to 3-9
        land use impacts, IIB 3-12 to 3-13
        noise impacts, IIB 3-10 to 3-12
        Proposed Action, IIB 3-15
        South Boston, IIB 3-1 to 3-15
        traffic and transportation issues, IIB 3-5 to 3-9
        visual impacts, IIB 3-13 to 3-14
    toll revenues, 20-47
    transportation of construction materials for, 20-25
    truck traffic and, 3-84
    tunnel foundation construction, 20-34 to 20-35
    underwater rock excavations for, 17-12
    visual impacts, 9-11 to 9-12
    water transportation and, 3-95

Third Harbor Tunnel Area,
  changes since FEIS/R, 2-12
  pedestrian circulation during construction, 20-29
  Proposed Action description, 2-9
  proposed major traffic improvements, 2-9
Tidelands,
  filled,
    Boston Inner Harbor, 14-29, 14-48 to 14-49
    Fort Point Channel, 14-16
    Lower Charles River, 14-11 to 14-12
  flowed,
    Boston Inner Harbor, 14-24 to 14-29, 14-48
    Fort Point Channel, 14-15 to 14-16
    Lower Charles River, 14-8 to 14-11
  Spectacle Island, IIB 4-125
  Waterways Licensing Program and, 14-2
Till. *See* Clay and till
Time delays,
  for industrial/manufacturing sector, 7-40 to 7-41
  office demand and, 7-36
Time savings, analysis of, 7-51 to 7-54, 7-57
Tobin Bridge, projected traffic operations, 3-36, 3-66
Total suspended particulate (TSP) matter levels, concrete batch plant operation and, 20-57 to 20-60
Tourism,
  construction impacts on, 20-48
  destination areas for, 7-45, 7-47 to 7-48
  economics, 7-18 to 7-20
  impacts on, 7-44 to 7-50, 7-51
  long-term impact on, 7-50
Tower A, IIB 1-65, IIB 1-80, IIB 1-81, 10-8, 10-17
Toxic air pollutants, 4-3 to 4-5
Traffic,
  construction impact changes since FEIS/R, 20-100
  construction impacts, 20-16 to 20-36
    Area North of Causeway Street, 20-18 to 20-20
    systemwide, 20-16 to 20-18
  increase in, 3-1 to 3-2
  long-term benefits, 19-2
  maintenance of, 20-95 to 20-99, 20-100, 20-105
  South Boston Haul Road impacts, IIB 2-10 to 2-17
  vibration and, 5-30, 20-67
Traffic congestion,
  construction, air quality impacts, 20-54
  duration of, 3-72 to 3-73
  existing, 3-14 to 3-15
  projected, 3-23
  utility relocations and, 20-51
Traffic and Emergency Control Center (TECC), 3-4

Traffic management,
  improvements, 3-4, 7-56
  for noise impact mitigation, 5-25 to 5-26
  Third Harbor Tunnel toll plaza locations and, IIB 3-1 to 3-2
Traffic noise, 5-2 to 5-23, 5-25 to 5-26
Traffic operations, 3-6 to 3-16
  Area North of Causeway Street, 3-10, 3-14
  2010 baseline condition, 3-26
  2010 build condition, 3-26
  CANA project, IIB 1-9, IIB 1-10, IIB 1-12 to 1-14
  Central Area, 3-14 to 3-15
  East Boston/Logan Airport, 3-16
  forecasting model for, 3-26
  Interchange Area, 3-15 to 3-16
  Option 5A Modified, IIB 1-18, IIB 1-19, IIB 1-23 to IIB 1-37
  Option S Modified, IIB 1-19, IIB 1-20, IIB 1-23, IIB 1-25, IIB 1-27 to 1-37
  Option T Modified, IIB 1-20 to 1-23, IIB 1-25, IIB 1-27 to 1-36
  Option Z Modified, IIB 1-21 to 1-24, IIB 1-26 to 1-36
  projected, 3-24, 3-52 to 3-72
    Area North of Causeway Street, 3-66 to 3-67
    by subarea, 3-66 to 3-72
    Central Area, 3-67 to 3-69
    East Boston/Logan Airport, 3-71 to 3-72
    Interchange Area, 3-69
    projectwide, 3-52 to 3-66
    South Boston, 3-70
  South Boston, 3-16
  in study area, 3-6 to 3-10
Traffic safety,
  Central Artery, 3-19 to 3-20
  projected improvements in, 3-85 to 3-86
Traffic speed, projected, 3-53
Traffic Surveillance and Control System (TSCS), 3-100, 4-32
Traffic volumes, 3-4
  existing and projected, 3-27 to 3-39
  forecasting, 3-26
  peak hour, existing and projected, 3-39 to 3-52
Transit, public. *See* Public transit
Transition sections, construction activities, 20-2
Transit parking facilities, as mitigation measures, 3-104
Transportation, 3-1 to 3-108
  affected environment, 3-1 to 3-22
  analysis methodology, 3-24 to 3-26
  compared with FEIS/R, 3-106 to 3-107
  demand forecasts, 3-27 to 3-39
  of dredged and excavated materials, IIB 4-7 to 4-15
  employment forecasts, 7-30
  environmental consequences, 3-1, 3-23 to 3-99
  long-term benefits, 19-2

  - mitigation measures, 3-99 to 3-106
  - project impacts on, 3-23 to 3-24, 18-6
  - resolution of issues raised by agencies, 3-108
  - system efficiency benefits, 7-51 to 7-54
- Transportation Access Plans, 3-4
- Transportation and Construction Coordinating Committee (TRANSCCOM), 20-106
- Travel delays,
  - projected, 3-53
  - reduction benefits, 7-53 to 7-54
- Travel time, without Proposed Action, 3-23, 3-25, 3-53
- Truck traffic,
  - for construction materials delivery, 20-5
  - during construction,
    - Area North of Causeway Street, 20-19
    - Central Area, 20-20, 20-21 to 20-22
    - East Boston/Logan Airport Area, 20-26 to 20-27
    - Interchange Area, 20-23 to 20-24
    - South Boston, 20-24 to 20-25
  - East Boston/Logan Airport, 3-75, 3-84, 20-26 to 20-27
  - existing, 3-17
  - fugitive dust emissions from, 20-54 to 20-55
  - inflammable cargo, 3-17, 3-84 to 3-85
  - for materials disposal program, IIB 4-10 to 4-11, IIB 4-144, 20-5
  - projected, 3-75, 3-84 to 3-85
  - projected delay reduction for, 7-40 to 7-41
  - in South Boston, 1-9, 2-8, 3-16, 3-17, 3-75, 3-84, 20-24 to 20-25
  - South Boston, bypass alternatives, IIB 2-4 to 2-6, IIB 2-8, IIB 2-10
  - South Boston Bypass Road and, IIB 2-4 to 2-6, IIB 2-8, IIB 2-10, IIB 2-11, IIB 2-1 to 2-2
  - South Boston Haul Road and, IIB 2-2
  - South Boston studies on, IIB 2-2 to 2-6
  - time savings impacts, 7.51 to, 7-54
- Tunnels,
  - Boston Inner Harbor, 20-74 to 20-75
  - carbon monoxide concentrations in, 4-41
  - Central Area, 2-4 to 2-5
  - changes since FEIS/R, 9-20
  - cut-and-cover, 20-2 to 20-3
  - design of, 4-41 to 4-42, 9-12, 9-18
  - fires in, 4-33
  - Fort Point Channel, 14-40 to 14-42, 20-76 to 20-77
  - groundwater impacts, 13-35
  - interior environment, 9-11 to 9-12
  - MBTA, protection of, 20-8, 20-31
  - noise impacts at, 5-25
  - rock removal for, 20-22
  - stormwater runoff and, 13-36
  - under Fort Point Channel, 13-26 to 13-30
  - ventilation of, 2-15, 4-42 to 4-46
  - visual impacts, 9-11 to 9-12, 9-18
  - wastewater generated by, 13-33 to 13-34

Turbidity plume, 20-73
Turner Fisheries loading dock, 20-8

Underpinning, 20-8, 20-85
Underwater blasting,
    in Boston Inner Harbor, 20-70 to 20-73
    short-term impacts, 19-2
    vibration and, 20-66
Union Park, III 32
Utilities, 12-1 to 2-15
    affected environment, 12-11
    construction activities, 20-7
    construction impacts, 20-49 to 20-53, 20-101 to 20-102
    environmental consequences, 12-2 to 12-14
    mitigation measures, 12-14, 20-101 to 20-102
    resolution of issues raised by public agencies, 12-15
Utility relocation,
    Area North of Causeway Street, 20-51
    Central Area, 12-12, 20-51 to 20-52
    construction impact changes since FEIS/R, 20-103
    East Boston/Logan Airport Area, 12-12, 20-53
    Interchange Area, 20-52
    method of, 12-11
    scheduling and service disruptions, 20-50 to 20-51
    South Boston, 20-52
    traffic control and special coordination, 20-51

Value engineering, IID.1
Vegetation and wildlife, 16-1 to 16-12. *See also* Wildlife
    affected environment, 16-1
    environmental consequences, 16-1
    impacts, compared with FEIS/R, 16-2
    mitigation measures, 16-2
    Spectacle Island, IIB 4-89 to 4-90
Vehicle hours traveled (VHT),
    projected, 3-73 to 3-75
    with Proposed Action, 3-24
    reduction in, 7-3
Vehicle miles traveled (VMT),
    energy consumption and, 6-1
    projected, 3-73 to 3-75
    with Proposed Action, 3-24
Vehicular fuel consumption, 6-1 to 6-3
Ventilation building 1,
    changes since FEIS/R, 9-20
    historic resources impacts, 10-16
    land use impacts, 8-16
    noise impacts, 5-23
    visual impacts, 9-15 to 9-16

Ventilation building 2,
  changes since FEIS/R, 9-20
  historic resources impacts, 10-14, 10-16
  land use impacts, 8-17
  visual impacts, 9-16
Ventilation building 3,
  changes since FEIS/R, 9-20
  historic resources impacts, 10-13, 10-16, 10-18, 10-19
  land use impacts, 8-17, 8-25
  visual impacts, 9-16
Ventilation building 4,
  changes since FEIS/R, 9-20
  historic resources impacts, 10-17
  land use impacts, 8-17, 8-25
  noise impacts, 5-23
  visual impacts, 9-16
Ventilation building 5,
  changes since FEIS/R, 9-20
  historic resources impacts, 10-16
  land use impacts, 8-17
  noise impacts, 5-25
  visual impacts, 9-16 to 9-17
Ventilation building 6,
  changes since FEIS/R, 9-21
  Designated Port Area and, 14-48 to 14-49
  land use impacts, 8-17
  noise impacts, 5-23, 5-25
  visual impacts, 9-17
Ventilation building 7,
  changes since FEIS/R, 9-21
  land use impacts, 8-17
  noise impacts, 5-23, 5-25
  visual impacts, 9-17
Ventilation buildings, 4-46 to 4-70
  air quality impacts, 4-48 to 4-71
  air quality modeling procedures for, 4-48 to 4-56
  alternative concepts for, 4-46
  changes since FEIS/R, 9-20 to 9-21
  design modifications considered, IID.2, IID.3
  design of, 4-59, 9-19
  emissions from, 4-48
  Fort Point Channel impacts, 14-43
  historic resources impacts, changes since FEIS/R, 10-18 to 10-19
  joint development of, 8-17
  land use impacts, 8-16 to 8-17
  location of, 4-1
  Memorandum of Agreement and, 10-16
  mobile source impacts and, 4-69 to 4-70
  noise impacts, 5-23 to 5-25

- Proposed Action description, 2-15
- proposed sites, 4-46
- site selection for, 2-15, 4-46 to 4-48
- ventilation requirements, 4-43 to 4-44
- visual impacts, 9-15 to 9-17, 9-19

Ventilation Building Site Report, 2-15

Vibration,
- affected environment, 5-35
- changes since FEIS/R, 5-36
- construction impacts, 20-63 to 20-69, 20-105
- construction period mitigation measures, 20-103
- criteria, 20-63 to 20-65
- environmental consequences, 5-35
- estimated levels, 20-63
- existing levels, 5-30, 5-35
- mitigation measures, 5-35
- resolution of issues raised by public agencies, 5-36

Visitor industry, 7-18 to 7-20, 7-51

Visual characteristics, 9-1 to 9-21
- affected environment, 9-1 to 9-5
- changes since FEIS/R, 9-1, 9-9 to 9-21
- environmental consequences, 9-6 to 9-17
- existing environment,
  - Area North of Causeway Street, 9-1 to 9-2
  - Central Area, 9-2 to 9-4
  - East Boston/Logan Airport Area, 9-5
  - Interchange Area, 9-4
  - South Boston and Boston Bypass Road Area, 9-4 to 9-5
- mitigation measures, 9-17 to 9-19
- resolution of issues raised by public agencies, 9-21
- Spectacle Island, IIB 4-91

Visual impacts. *See also* Aesthetic and visual impacts
- Area North of Causeway Street, IIB 1-57 to 1-63, IIB 1-82
- CANA project, IIB 1-61
- Central Area, 9-6
- construction, 20-83 to 20-88
- Paul Revere Landing Park, IIB 1-58, IIB 1-59, IIB 1-62
- South Boston Haul Road, IIB 2-24
- Spectacle Island, IIB 4-124
- Third Harbor Tunnel toll plaza locations and, IIB 3-13 to 3-14
- of ventilation buildings, 9-15 to 9-16

"Walk to the Sea", visual impacts to, 9-13

Washington Street Replacement Transit Service, 3-102

Wastewater, project-generated, 13-33 to 13-34, 13-40

Waterfront area,
- land use, 8-7, 8-25 to 8-26
- as tourist destination area, 7-47, 7-48

Waterfront (Columbus) Park, noise barrier analysis for, 5-27

Water quality, 13-1 to 13-42
  affected environment, 13-1 to 13-26
  Boston Inner Harbor, 13-8 to 13-16, 13-30 to 13-31
  changes since FEIS/R, 13-1, 13-40 to 13-41
  construction impact changes since FEIS/R, 20-103
  dredging and, 20-70 to 20-73
  environmental consequences, 13-26 to 13-41
  Fort Point Channel, 13-1 to 13-8, 13-26 to 13-30, 20-75 to 20-79
  Lower Charles River, 13-16 to 13-23, 13-31 to 13-33
  major findings, 13-41 to 13-42
  Millers River, 13-16 to 13-23, 13-31 to 13-33
  mitigation measures, 13-39 to 13-40
  projectwide issues, 13-33 to 13-39
    groundwater, 13-33 to 13-34, 13-35, 13-40, 13-41
    industrial water use, 13-35 to 13-36
    sewage, 13-34 to 13-35, 13-41
    stormwater runoff, 13-36 to 13-39
    tunnel wastewater, 13-33 to 13-34, 13-40, 13-41
  resolution of issues raised by public agencies, 13-42
  South Boston Haul Road, IIB 2-23
  Spectacle Island, IIB 4-85, IIB 4-119 to 4-120
Water resources,
  construction impact changes since FEIS/R, 20-103
  construction impacts, 20-69 to 20-82
    Boston Inner Harbor, 20-70 to 20-75
    Charles River, 20-79 to 20-80
    Fort Point Channel, 20-75 to 20-79
    Millers River, 20-80 to 20-81
    mitigation measures, 20-103 to 20-104
    projectwide, 20-81 to 20-83
Water supply impacts, of materials disposal program, IIB 4-140
Water transportation,
  Boston Inner Harbor, 14-24
  impacts to, 3-95
  as mitigation measure, 3-105
  for Third Harbor Tunnel construction materials, 20-25
Waterways, 14-1 to 14-52. *See also* specific waterways
  affected environment, 14-3 to 14-29
  changes since FEIS/R, 14-51 to 14-52
  environmental consequences, 14-29 to 14-49
  Lower Charles River, 14-3 to 14-12
  Millers River, 14-3 to 14-8
  mitigation measures, 14-49 to 14-51
  regulations affecting, 14-1 to 14-2
  resolution of issues raised by public agencies, 14-52
Waterways Licensing Program, 14-1 to 14-2
Weaving sections, accident rates and, 3-85
West End, land use, 8-4, 8-24, 8-41
31 West Fifth Street, noise barrier analysis for, 5-29

Wetlands, 14-1 to 14-52
    affected environment, 14-3 to 14-29
    Boston Inner Harbor, 14-18 to 14-24, 14-47 to 14-48, 20-70 to 20-75
    changes since FEIS/R, 14-51 to 14-52
    construction impact changes since FEIS/R, 20-103
    displacement of, 18-2
    environmental consequences, 14-29 to 14-49
    Fort Point Channel, 14-13 to 14-15, 20-78 to 20-79
    Lower Charles River, 14-5 to 14-8, 20-79
    Millers River, 14-5 to 14-8, 20-80 to 20-81
    mitigation measures, 14-49 to 14-51
    replacement of, 14-49
    resolution of issues raised by public agencies, 14-52
Weymouth disposal site, IIB 4-65 to 4-69, IIB 4-99 to 4-101
Wheelabrator Eastern, 20-7
Wholesale trade,
    construction impacts, 20-45
    impacts on, 7-40 to 7-43, 7-51
Wildlife. *See also* Vegetation and wildlife
    Boston Inner Harbor, 14-19 to 14-24
    construction impacts to, 20-82 to 20-83
    Fort Point Channel, 14-14 to 14-15
    Lower Charles River, 14-6 to 14-8
    materials disposal program impacts, IIB 4-140 to 4-141
    Spectacle Island, IIB 4-86 to 4-87, IIB 4-121 to 4-124
Wye railroad connector, 10-16

Yankee Lobster, construction impacts to, 20-82

Zinc, in dredged materials, 20-73